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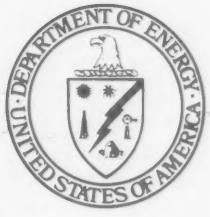
September 30, 1988

Energy Research Abstracts

Abstracts 42546-44544



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ENERGY RESEARCH ABSTRACTS

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Energy Research Abstracts (ERA) provides abstracting and indexing coverage of all scientific and technical reports, journal articles, conference papers and proceedings, books, patents, theses, and monographs originated by the U. S. Department of Energy, its laboratories, energy centers and contractors. *ERA* also covers other energy information prepared *in report form* by federal and state government organizations, foreign governments, and domestic and foreign universities and research organizations. **The user should remain aware that *ERA* coverage of non-report literature is limited to that generated by Department of Energy activity.**

ERA is comprehensive in its subject scope, encompassing the DOE's research, development, demonstration, and technological programs resulting from its broad charter for energy sources, supplies, safety, environmental impacts, and regulation.

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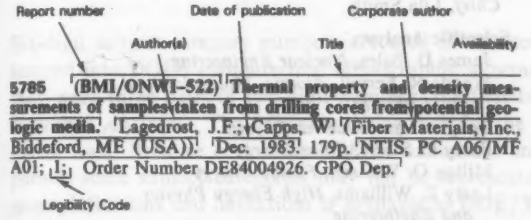
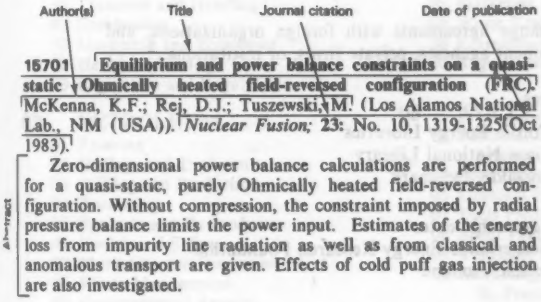
The principal elements of abstract entries for a typical research and development report and a typical technical journal article are illustrated below.



5785 (BMI/ONWI-522) Thermal property and density measurements of samples taken from drilling cores from potential geologic media. Lagedrost, J.F.; Capps, W. (Fiber Materials, Inc., Biddeford, ME (USA)). Dec. 1983. 179p. NTIS, PC A06/MF A01; 1; Order Number DE84004926. GPO Dep.

Density, steady-state conductivity, enthalpy, specific heat, heat capacity, thermal diffusivity and linear thermal expansion were measured on 59 materials from core drill samples of several geologic media, including rock salt, basalt, and other associated rocks from 7 potential sites for nuclear waste isolation. The measurements were conducted from or near to room temperature up to 500°C, or to lower temperatures if limited by specimen cracking or fracturing. Ample documentation establishes the reliability of the property measurement methods and the accuracy of the results.



15701 Equilibrium and power balance constraints on a quasi-static, Ohmically heated field-reversed configuration (FRC). McKenna, K.F.; Rej, D.J.; Tuszewski, M. (Los Alamos National Lab., NM (USA)). *Nuclear Fusion;* 23: No. 10, 1319-1325 (Oct 1983).

Zero-dimensional power balance calculations are performed for a quasi-static, purely Ohmically heated field-reversed configuration. Without compression, the constraint imposed by radial pressure balance limits the power input. Estimates of the energy loss from impurity line radiation as well as from classical and anomalous transport are given. Effects of cold puff gas injection are also investigated.

INDEXES TO *ENERGY RESEARCH ABSTRACTS*

Five indexes are provided for approaching the contents of each issue of *Energy Research Abstracts (ERA).* Each index is preceded by an introduction that details the organization of the index and the principles by which it was compiled. The reader is referred to these introductions for information not found in the index examples that follow.

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Technical report literature is indexed using the name of the organization or institution responsible for the issuance of the report.

5785 (BMI/ONWI-522) Thermal property and density measurements of samples taken from drilling cores from potential geologic media. Lagedrost, J.F.; Capps, W. **(Fiber Materials, Inc., Biddeford, ME (USA)).** Dec. 1983. 179p. NTIS Order Number DE84004926. GPO Dep.

is indexed as:

Fiber Materials, Inc., Biddeford, ME (USA)

• Personal Author Index

Each author's name is indexed in the form appearing on the document abstracted, with the exception that given names are reduced to initials:

Capps, W., *See* Lagedrost, J. F.
Lagedrost, J.F., Thermal property and density measurements of samples taken from drilling cores from potential geologic media, 9:5785 (R;US)
McKenna, K.F., Equilibrium and power balance constraints on a quasi-static Ohmically heated field-reversed configuration (FRC), 9:15701 (J;US)
Rej, D.J., *See* McKenna, K.F.
Tuszewski, M., *See* McKenna, K.F.

• Subject Index

The subject index consisting of entries naming specific materials, objects, and processes is arranged alphabetically. Document titles, informative phrases, or both specific to these entries are arranged alphabetically under the entries.

SALT DEPOSITS
Density
Thermal property and density measurements of samples taken from drilling cores from potential geologic media, 9:5785 (R;US)
REVERSED-FIELD PINCH
Energy Balance
Equilibrium and power balance constraints on a quasi-static Ohmically heated field-reversed configuration (FRC), 9: 15701 (J;AT)

• Contract Number Index

DOE technical report literature is indexed using contract numbers. This index contains the contract number with corresponding abstract and report numbers.

AC06-76RL01830	**Fiber Materials, Inc., Biddeford, ME (USA)**	
	9:5785	BMI/ONWI-522

• Report Number Index

Technical report literature is also indexed using report numbers. This index includes information on where individual reports may be obtained. Patents and conference papers are indexed here as a matter of convenience. When a report is supplied under an Order Number, that number is included in the availability statement. An Order number–report number correlation is included for convenience.

BMI/ONWI-522	9:5785	NTIS, PC A09/MF A01. Order Number DE84004926, Distribution Category MN-70

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IEA Biomass Conversion Service
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Bethesda, MD

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Commack, NY

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ENERGY RESEARCH ABSTRACTS

01 COAL AND COAL PRODUCTS

REFER ALSO TO CITATION(S) 43292

0103 Preparation

REFER ALSO TO CITATION(S) 42570, 42607

42546 (CONF-850982—, pp 25-32) **New reagent design for coal flotation.** Hu, W.B.; Yu, G.; Guo, M.X. (Univ. of Utah, Salt Lake City (USA)). 1985. NTIS, PC A99/MF A01. Order Number DE88007794/JAW.

From 2. annual Pittsburgh coal conference; Pittsburgh, PA, USA (16 Sep 1985).

The main purpose of this study was to improve the flotability of low rank coals. In order to dispel the hydrophilic effect of oxygen-containing functional groups, new heteropolar reagents or surfactants were screened. Reagents were chosen which have a polar end and can absorb on or react with the oxygen-containing group to depress the surface hydrophilicity and a nonpolar end directed to the water to expel the water dipole, thus changing the surface to a hydrophobic, oilphilic, and flotable condition. Based on the screening tests, new reagents were developed and have been verified in large-scale plants. Performance data are presented. 6 tables.

42547 (CONF-850982—, pp 34-42) **Effect of fine grinding on the production of superclean coal by flotation.** Miller, K.J.; Wen, W.W. 1985. NTIS, PC A99/MF A01. Order Number DE88007794/JAW.

From 2. annual Pittsburgh coal conference; Pittsburgh, PA, USA (16 Sep 1985).

Because of the growing need to develop new technology for producing superior quality coals to replace oil and natural gas, the US Dept. of Energy's Coal Preparation Division is looking at fine grinding and multistage flotation processes to maximize the liberation and removal of sulfur-bearing and ash-forming mineral matter from coal. The beneficiation of micronized coal by froth flotation has long been considered unsatisfactory because of poor product quality and/or poor recovery. However, recent studies have shown that ultrafine coal can be cleaned to very low ash levels if the appropriate grinding procedure is used to prepare the coal and if a relatively low-ash feed is used. For example, wet grinding assures a much lower ash froth concentrate than does dry grinding. In addition, work now in progress suggests that superclean products of high yield can be obtained by a combination of coarse coal cleaning of rougher flotation, followed by wet grinding and recleaning by second-stage and third-stage coal flotation. For example, by a combination of rougher flotation, wet grinding of the rougher concentrate, and two-stage coal flotation of the wet-ground product, an Upper Freeport bed coal sample was cleaned from 26% ash and 1.1% pyritic sulfur to 4.5% ash and 0.1% pyritic sulfur.

42548 (CONF-850982—, pp 43-54) **Improvements in recovery and selectivity with the microbubble flotation process.** Luttrell, G.H.; Keyser, P.M.; Adel, G.T.; Yoon, R.H. (Virginia Polytechnic Institute and State Univ., Blacksburg (USA)). 1985. NTIS, PC A99/MF A01. Order Number DE88007794/JAW. Contract FG22-83PC60806.

From 2. annual Pittsburgh coal conference; Pittsburgh, PA, USA (16 Sep 1985).

It has been shown previously that in cleaning ultrafine coal by flotation, the use of microbubbles improves both recovery and selectivity as compared to the conventional flotation process. The increased recovery associated with microbubbles has been found to result from the improved hydrodynamic conditions for bubble-particle collision. The improved selectivity, on the other hand, can be attributed to the absence of a wake behind the rising bubble. It has been found that when using larger bubbles, particles are entrained in the wake volume, which results in reduced selectivity. The benefits of using microbubbles have been demonstrated in a series of continuous flotation experiments using a column-type flotation cell. A model for the flotation rate constant has been developed by combining flotation due to adhesion and flotation due to entrainment. The rate constants determined experimentally using a frothless flotation cell have been found to be in good agreement with those predicted by the model over a wide range of bubble sizes.

42549 (CONF-850982—, pp 55-62) **Round robin testing of advanced selective agglomeration and flotation processes.** Killmeyer, R.P. 1985. NTIS, PC A99/MF A01. Order Number DE88007794/JAW.

From 2. annual Pittsburgh coal conference; Pittsburgh, PA, USA (16 Sep 1985).

There has been a good deal of effort among coal research organizations during the last few years to develop novel ultrafine-coal-cleaning processes as a means to produce superclean coal for advanced coal utilization applications. One of the best ways of cleaning fine coal is to take advantage of the difference in surface chemistry between the coal macerals (hydrophobic) and the mineral matter (hydrophilic), as in froth flotation and selective agglomeration. The objective of this study was to determine the extent of technical advances in the state-of-the-art of ultrafine coal cleaning. Samples of coal were distributed to several organizations which beneficiated the coal sample using its process and then returned the samples of clean coal and refuse to DOE for analysis and reporting. This paper describes the processes used and the results from each; however, the organizations and processes are not identified by name. This was done to encourage participation without risk, to develop a spirit of cooperation, and to eliminate the competitive aspect of such a comparison. 4 tables.

42550 (CONF-850982—, pp 63-82) **Commercializing electrostatic dry coal cleaning.** Lipari, P.F.; Feldmann, B.E. (Advanced Energy Dynamics, Inc., Natick, MA (USA)). 1985. NTIS, PC A99/MF A01. Order Number DE88007794/JAW.

From 2. annual Pittsburgh coal conference; Pittsburgh, PA, USA (16 Sep 1985).

Advanced Energy Dynamics, Inc. (AED) has completed the first full scale electrostatic dry coal cleaning demonstration in the US. Electrostatic dry coal cleaning will provide a relatively low cost alternative to improving the acid rain situation and increase utilization of domestic coal. AED is developing two electrostatic dry coal cleaning processes (referred to as the Fine Coal and Ultra-Fine Coal Processes) which utilize electro-mechanical equipment in lieu of chemical systems. Ongoing scale-up activities continue to confirm these systems' superior performance and economics when compared to conventional flotation cleaning. More important to plant owners is the resulting increase in combustion efficiency, boiler reliability, and reduced operating costs associated with using lower cost cleaned coal than naturally occurring low sulfur coal. The first demonstration plant was a 4.5 ton/hr Fine Coal system located in Ohio. The objective of the program was to demonstrate the cleaning of selected Ohio coals. This was done as part of the Ohio Dept. of Development Division of Energy (ODOE) Improved Coal Utilization Program. The plant demonstrated an ability of certain coals to remove 40% of the ash and 40% of the sulfur from the coal being processed. AED will also be demonstrating its Ultra-Fine Coal system as an extension of ODOE's program. Based on AED's demonstration program and their recent developments,

AED expects various commercial coal cleaning projects to be initiated in the near future.

42551 (CONF-850982—, pp 83-100) **Cleaning Texas lignite for electric utility use.** Akers, D.J.; Harrison, C.D. (Science Applications International Corp., Homer City, PA (USA)). 1985. NTIS, PC A99/MF A01. Order Number DE88007794/JAW.

From 2. annual Pittsburgh coal conference; Pittsburgh, PA, USA (16 Sep 1985).

This paper describes a feasibility study to determine whether lignite fines could be cleaned. In general, the lignite fines were found to have a reasonable potential for beneficiation, including the reduction of the erosive properties of the fuel. Also, the materials handling and sampling systems of the Coal Cleaning Test Facility, CCTF, were adequate for this lignite. The only special problem encountered was the tendency of the clean coal to self-heat. Although this work was intended only as a feasibility study, limited in scope, the following conclusions can be drawn. The lignite did not offer any special handling problems at the CCTF. Ash, sulfur, and free quartz were reduced by cleaning; potential SO_2 emissions were reduced from 2.89 to 1.87; Btu content increased by cleaning. The percent increase was small (6%), but the absolute increase of almost 700 Btu/lb is significant. Moisture content was unchanged by cleaning. Plant clean coal was more subject to spontaneous heating than was the raw coal or refuse. Calculated slagging and fouling indices were not affected by cleaning. Crushing the raw lignite from a top-size of 6-in to 1/4-in resulted in large improvements in theoretical yield and energy recovery relative to clean coal ash and lbs SO_2/MBtu content. 9 tables.

42552 (CONF-850982—, pp 261-272) **Findings of a symposium on coal quality.** Schweinfurth, S.P.; Garbini, S. (Geological Survey, Reston, VA (USA)). 1985. NTIS, PC A99/MF A01. Order Number DE88007794/JAW.

From 2. annual Pittsburgh coal conference; Pittsburgh, PA, USA (16 Sep 1985).

The coal-quality symposium at the USGS National Center, in April 1985, provided a forum for the discussion of a wide variety of topics with regard to coal-quality research and related activities. The coal community took advantage of that opportunity to recommend a large agenda of coal-research needs, not only for the USGS but for the entire spectrum of organizations that either actively pursue or fund research on coal quality. The USGS is currently analyzing the proceedings of the symposium to determine how well its current research program fits with the recommendations made and how best to modify and/or expand its program to provide the kind of coal-resource characterization information that will be most useful to the Nation. This paper discusses the five workshops and the recommendations that resulted from them. Topics of the workshops were: characterization of the quality of coal resources and reserves; coal utilization and procurement; coal mining and coal cleaning; environmental issues; and advanced technologies for coal utilization.

42553 (CONF-850982—, pp 332-343) **Automatic product-quality control for coal cleaning plants.** Shea, S.C.; Sehgal, R.S. (Praxis Engineers, Inc., Milpitas, CA (USA)). 1985. NTIS, PC A99/MF A01. Order Number DE88007794/JAW.

From 2. annual Pittsburgh coal conference; Pittsburgh, PA, USA (16 Sep 1985).

The paper describes a generalized approach to the development of an on-line quality feedback control system for a coal cleaning plant, with specific reference to Tennessee Valley Authority's Paradise Wash Plant. The basis for control is supplied by an on-line sulfur meter which provides sulfur content values for the plant product in real time. These readings, combined with other process variables such as media gravities and reagent dosages for the flotation circuits, are used to calculate the plant settings required to regulate product quality at or near compliance with SO_2 emission limits. The techniques for developing the requisite coal models are discussed, along with their interaction with plant performance parameters. It is concluded that most large coal cleaning plants operating under strict quality requirements can use automatic quality control systems profitably. However, the need for economic analysis on a case-by-case basis is important and is recommended.

42554 (CONF-850982—, pp 525-532) **Optimizing the economics of burning coal-water slurry.** Woessner, P.W.; Anast, K.R. (AMAX Coal Co., Indianapolis, IN (USA)). 1985. NTIS, PC A99/MF A01. Order Number DE88007794/JAW.

From 2. annual Pittsburgh coal conference; Pittsburgh, PA, USA (16 Sep 1985).

Coal-water slurries (CWS) are one of the most advantageous alternatives to oil since they eliminate the requirements for on-site coal handling and dependence on high cost fuel oils. Modern coal preparation technology has made it possible to produce CWS with low ash content and realistic physiological properties which minimize unit derating. Recent work by AMAX Inc. and others has made it possible to produce pumpable slurries containing over 70% dry coal, less than 28% moisture, and additives. Variations in coal concentration, coal particle size, and customer slurry flow requirements ultimately determine the amounts of additive required to produce a serviceable fuel. Since the introduction of coal-water slurries, researchers have attempted to maximize the coal concentration in the slurry. Highly-loaded slurries allow the consumer to transport and handle less fuel reducing the overall costs associated with transportation. However, highly-loaded slurries require increased amount of additives to maintain stability and flow properties. Increasing the additive concentration has a significant impact on the cost of manufacturing the slurry. For each power plant and method of transport there is an optimum coal-water slurry formulation to achieve the best overall economics. By evaluating the cost of generating power with different coal-water slurry formulations an optimum coal concentration may be determined. It is the intent of this paper to develop methods of parametrically evaluating coal-water slurries to determine the most economic coal-water slurry for a specific plant.

42555 (DOE/PC/90538—7) **Use of basic nitrogen to chemically clean coal: Quarterly report No. 6 for the period March 15, 1988-June 15, 1988.** Silver, H.F. (Wyoming Univ., Laramie (USA). Dept. of Chemical Engineering). 16 Jun 1988. Contract FG22-86PC90538. 8p. NTIS, PC A02/MF A01;1; GPO Dep. Order Number DE88012183/JAW.

Studies of the effect of the concentration of basic nitrogen compounds in coal derived distillates as solvents on coal desulfurization were continued. Mild coal liquefaction runs were made using a solvent consisting of 25 wt % tetramethylammonium hydroxide pentahydrate (TMAP) in a coal derived distillate. A comparison has been made of the results obtained from these runs and from earlier runs in which coal derived distillate or 5 wt % TMAP in distillate was used as the solvent. Under comparable reaction conditions, TMAP showed little if any positive effect on the desulfurization of the coal studies. However TMAP appears to have a small but positive effect on the conversion of lignite and subbituminous coal to pyridine soluble product. 2 tabs.

42556 (EPRI-CS—5774) **Coal quality information system: Users's manual: Interim report.** Parkinson, J.W.; Arnold, B.J.; Beean, L.K.; Baker, J.E.; Barrett, N.M.; Salvador, A.B. (Electric Power Research Inst., Palo Alto, CA (USA); Kaiser (Raymond) Engineers, Inc., Homer City, PA (USA); Science Applications International Corp., Homer City, PA (USA)). Jul 1988. 129p. Unlimited audience, publicly available. Research Reports Center, Box 50490, Palo Alto, CA 94303. Order Number TI88012904/JAW.

Declining coal quality, aging power plants, and tightening emissions regulations compact the job of selecting coals to achieve the lowest electricity cost. The EPRI Coal Quality Information System is a personal computer database that contains detailed information on coal quality and cleanability and can help utilities select the best coal for a given plant. This manual gives step-by-step instructions on how to use the CQIS. 9 figs., 2 tabs.

42557 (VTT-TIED—740) **Screening of chips.** Laine, R. (Valtion Teknillinen Tutkimuskeskus, Espoo (Finland)). Aug 1987. 60p. (In Finnish). NTIS (US Sales Only), PC A04/MF A01. Order Number DE88752089/JAW.

The goal of the study is to survey the screening of chips, especially of fuel chips on a production scale. Further on screening of

milled and sod peat is surveyed to some extent, because screening of these fuels resembles that of fuel chips. The study is based on literature and on interviews of users and researchers of domestic fuels. Screening of milled peat tries to remove large pieces from powdered fuel. Screening is made by grids or by disc screens. The powdered material is removed from sod peat in addition to over-large material. Screening devices include vibration conveyors, vibration screens or disc screens. Screening of pulpwood chips depends on the mill. Good chips for kraft pulping are 2-7 mm in thickness and 15-40 mm in length. Screening is usually done with a vibrating plate screen with horizontal motion. Other alternatives are plate screen with vertical motion, disc screen or drum screen. The crushing of large material is often a part of the screening system. Whole tree chips are often divided into fractions for pulping and for burning. The technical solutions for this purpose vary greatly. Delimbing and debarking drums combined with chippers and screens are used for handling of whole threes. The amount of bark in whole tree chips can be reduced in a drum or in a pulper which is followed by screening. Whole tree chips can be devided into fraction for pulping and burning also by only drum-, plate- or screw screens. The goal of the screening of chips for only burning is to remove large wooden and non-wooden particles. Fuel chips are nowadays screened fairly seldom. The boiler, its effect, types of conveyors and feeders all influence the need to screen. Screening is done with screen units mounted on chippers, grids in the reception of fuel or disc or plate screens. Of all types of chips primarily whole three chips need to be screened.

42558 **Oil agglomeration of coal in inorganic salt solutions.** Yang, G.C.C.; Markuszewski, R.; Wheelock, T.D. (Iowa State University (USA). Ames Laboratory and Dept. of Chemical Engineering). *Coal Preparation (Gordon and Breach);* **5**: No. 3/4, 133-146(1988).

Coal fines were suspended in water or in salt solutions for agglomeration with either heptane or paraffin oil. Coal recovery with a limited amount of oil was found to increase markedly as the salt concentration was raised. The increase in recovery appeared due to compression of the electrical double layer surrounding individual coal particles and oil droplets. The recovery was observed to depend on the pH of the suspension with the greatest recovery occurring at the isoelectric point. When a mixture of hydrophobic coal particles and kaolin particles was suspended in 1.5 m sodium chloride and agglomerated with paraffin oil at a level of 0.065 g oil/g coal, 95% of the coal was recovered and over 90% of the kaolin was rejected. This recovery was 265% greater than the recovery achieved by suspending the mixture in water and agglomerating it with the same amount of oil. These results show that the use of salt solutions in the oil agglomeration process can result in reduced oil consumption. 13 refs., 9 figs., 2 tabs.

42559 **Coal beneficiation.** Singh, S.P.N. (Oak Ridge National Laboratory, TN (USA). Chemical Technology Division). *Energy (Oxford);* **12**: No. 8/9, 805-812(Aug-Sep 1987).

This paper is an introduction to coal beneficiation. It includes a brief review of current commercial practices and several developmental coal-cleaning methods. Recent advances in coal beneficiation processes have been driven by environmental concerns and the desire to produce superclean or ultraclean coal to make coal-water slurry fuels. Coal-water slurry fuels are being developed as a potential replacement for No.6 fuel oil in oil-fired power plants. Some of these techniques may also find applications in coal gasification. Coal-beneficiation research should focus on attaining a better understanding of coal morphology and on developing innovative coal-cleaning methods that can yield high ash and sulfur removals from coal in a cost-effective manner. 18 refs., 4 figs., 2 tabs.

0104 Processing

REFER ALSO TO CITATION(S) 42559, 42598, 42648, 42676, 42678, 42678, 43038, 43602

42560 **(ACIRL-PR—87-5) Metallurgical coke manufacture and factors influencing its behaviour in the blast furnace.** Cudmore, J.F.; Handley, K. (Australian Coal Industry Research Labs. Ltd., North Ryde). Sep 1987. 143p. Australian Coal Industry Research Laboratories, North Ryde, Australia.

This report addresses the two main issues of blast furnace coke production technologies, including historical development, current conventional practices and recent developments, and coke behaviour in the blast furnace. Also covered are coal selection for coke making and coke oven blend design, and properties of world coking coals blends and cokes.

42561 (CONF-850982—, pp 103-110) **Companion processes for removal of sulfur and ash from coal.** Isbister, J.D.; Doyle, R.C.; Kobylinski, E.A.; Ayres, D.M.; Kitchens, J.F. (Atlantic Research Corp., Alexandria, VA (USA)). 1985. NTIS, PC A99/MF A01. Order Number DE88007794/JAW.

From 2. annual Pittsburgh coal conference; Pittsburgh, PA, USA (16 Sep 1985).

Atlantic Research Corporation has developed companion processes for removal of pyrite, ash and organic sulfur from fine coal. The organic sulfur removal is accomplished microbially while the pyrite and ash are physically separated using a microbial augmentation of surface property differences. The organic sulfur removal process uses a unique microbe, CBI, developed from a mixed culture of naturally occurring soil microorganisms by mutagenic alteration of the microbial DNA. This microorganism oxidizes the sulfur from thiophenes releasing the sulfur as water soluble sulfate. The organism does not break the carbon ring structure of the thiophene molecule. The Microbially Augmented Ash and Pyrite Physical Separation (MAAPPS) process uses a biological agent to enhance the differences between coal impurities (ash and pyrite) and the coal particles to promote efficiency separation of impurities from coal in a Flotaire column. This pyrite and ash removal process has been developed as an adjunct to microbial coal desulfurization. Both processes are described and an economic analysis of a plant using both processes is discussed.

42562 (CONF-850982—, pp 112-114) **Development of the TRW gravimelt process.** Meyers, R.A.; McClanathan, L.C.; Hart, W.D. (TRW Energy Development Group, Redondo Beach, CA (USA)). 1985. NTIS, PC A99/MF A01. Order Number DE88007794/JAW. Contract AC22-81PC42295.

From 2. annual Pittsburgh coal conference; Pittsburgh, PA, USA (16 Sep 1985).

The TRW Gravimelt Process is a Dept. of Energy supported chemical coal-cleaning process that removes virtually all of the sulfur and ash from any coal. Coal cleaned by the Gravimelt Process meets all EPA New Source Performance Standards (NSPS Standards) for sulfur oxide emissions and would eliminate the need for expensive and difficult-to-operate stack-gas scrubbers for all types of coal users - both utility and industrial. Gravimelt coal is as low in ash and sulfur as fuel oil. Thus the process offers many potential new markets for coal as a replacement for oil - including diesel or turbine fuel for generation of electricity and fuel for locomotives and trucks. The paper describes the process, gives typical process data, and discusses the economics.

42563 (CONF-850982—, pp 115-126) **Coal desulfurization and coal conversion with formates.** Wu, M.M.; Winschel, R.A. (Conoco Inc., Library, PA (USA)). 1985. NTIS, PC A99/MF A01. Order Number DE88007794/JAW.

From 2. annual Pittsburgh coal conference; Pittsburgh, PA, USA (16 Sep 1985).

This paper presents results of investigations into the potential of formate reagents (formic acid, calcium, ammonium and methyl formates and formamide) as media for coal desulfurization and coal

conversion. Methods exist to produce each of the investigated formate reagents from coal-based synthesis gas. Therefore, the reductant in any coal desulfurization or coal conversion process based on these formates could be produced from a portion of the feed coal or from a rejected by-product stream. Coals tested include Illinois 6 and Pittsburgh seam bituminous coals and North Dakota lignite.

42564 (CONF-850982—, pp 127-137) **Chemical desulfurization of coal with Caro's acid.** Lin, K.L.; Liu, D.C.; Markuszewski, R.; Bautista, R.G. (Ames Lab., IA (USA)). 1985. NTIS, PC A99/MF A01. Order Number DE88007794/JAW. Contract W-7405-ENG-82.

From 2. annual Pittsburgh coal conference; Pittsburgh, PA, USA (16 Sep 1985).

Caro's acid (H_2SO_5) is a relatively stable reagent, although it is a more powerful oxidizing agent than hydrogen peroxide. Because it has previously found some applications in hydrometallurgy as a leachant for uranium and other ores, its use was investigated in this work as a possible reagent for removing sulfur from coal. The effects of the amount and concentration of Cario's acid, the temperature, presence of hydrogen peroxide, and coal particle size on the desulfurization of coal have been investigated. Caro's acid was prepared from ammonium peroxydisulfate and sulfuric acid using a commercial procedure and was analyzed by conventional techniques. A typical preparation contained 11-14 H_2SO_5, 0.1-0.7 H_2O_2, 0.5 $H_2S_2O_8$, and 10-11.5 H_2SO_4 (all in wt. %). Its desulfurization potential was tested on an Illinois No. 6 run-of-mine coal (containing 34% ash, 4.2% total sulfur, and 2.0% pyritic sulfur) with a heating value of 9134 Btu/lb. Using -100 mesh coal, 10 wt. % Cario's acid, and a pulp density of 16%, it was possible to remove about 55% of the total sulfur from coal in one hour while stirring at an ambient temperature of 23 C. The recovery of coal and the recovery of heating value were about 90%. The percent desulfurization, leaching of iron, and consumption of Caro's acid were studies at different reaction conditions. Results are discussed. 16 references, 16 figures, 2 tables.

42565 (CONF-850982—, pp 138-154) **Desulfurization of Illinois coal by in situ preparation of iron sulfide catalysts.** Webster, J.R.; Shiley, R.H.; Hughes, R.E.; Lapish, P.L.; Cowin, D.K.; Smith, G.V.; Hinckley, C.C.; Nishizawa, T.; Yoshida, N.; Wiltowski, T. (Illinois State Geological Survey, Champaign (USA)). 1985. NTIS, PC A99/MF A01. Order Number DE88007794/JAW.

From 2. annual Pittsburgh coal conference; Pittsburgh, PA, USA (16 Sep 1985).

A three step pyrolytic desulfurization process that users the catalytic properties of a troilite (FeS)/troilite B ($Fe_{16}S_{17}$) mixture is currently being developed for Illinois Basin high-sulfur coals. In the first step, pyrite and marcasite present in the coal are reduced to a troilite/troilite B mixture by reaction with carbon monoxide at 375 C. Up to 50% of the pyritic sulfur is removed as carbonyl sulfide (OCS). The second step uses the catalytic troilite/troilite B to convert ethanol to atomic hydrogen (H°) and acetaldehyde. The atomic hydrogen, in turn, hydrogenates organic sulfur in the char and removes it as hydrogen sulfide. The third step, not yet fully defined, is to remove the iron sulfide catalyst by oxidation. The process was designed on principles discovered through detailed study of the catalytic properties of iron sulfides and the reactions important to coal desulfurization. Understanding the reactions in which iron sulfides participate is vital to manipulate sulfur equilibria to lower organic sulfur concentrations. Flowing gas conditions were found to provide the means necessary to avoid the recombination of sulfur products (back reactions) with coal/char. Moreover, this removal of sulfur favors the formation of troilite, which is the only pyrrhotite found to catalyze the liberation of thiophenic sulfur. Important factors also found to increase the effectiveness of desulfurization process are temperatures up to 550 C, increased contact between reactant gases and the coal/char, and the prevention of oxidation of the coal prior to treatment. Desulfurization of 9 Illinois Basin coals has produced chars with less than 0.6 percent sulfur.

42566 (CONF-850982—, pp 326-331) **Underground coal gasification: an update on the leading coal conversion technology for lower-priced gas.** Hammesfahr, F.W.; Winter, P.L. (Hammesfahr, Winter & Associates, Bernardsville, NJ (USA)). 1985. NTIS, PC A99/MF A01. Order Number DE88007794/JAW.

From 2. annual Pittsburgh coal conference; Pittsburgh, PA, USA (16 Sep 1985).

The July, 1985, issue of the American Gas Association's monthly statistical bulletin places the price of fuels delivered to the industrial consumer as ranging from $4.21/MM Btu for natural gas to $4.39 to $4.76/MM Btu for No. 6. fuel oil depending on sulfur content. Natural gas prices to industrial consumers have been flat since 1983 and possibly 1982 depending on data base used. It is against that price level that synthetic gasification technologies must compete for creditability and for developmental funding. It is tough competition. Nevertheless, there is one coal gasification technology - the in situ gasification of coal or underground coal gasification, UCG as is commonly called, that has been proceeding forward to an extent not generally appreciated. Its capital costs are low and its price forecasts indicate it is approaching competitiveness in the market place. The paper discusses the economics, technology, and status of UCG. As far as the authors are aware, there is no coal gasification technology at any comparable state of development offering the same potential reduction in the cost of coal fuel and synthesis gas. The authors regard UCG as the leading contender among the third generation coal gasification technologies.

42567 (CONF-850982—, pp 369-381) **Low severity catalytic liquefaction of Illinois No. 6 and Wyodak coals.** Comolli, A.G.; McLean, J.B. (Hydrocarbon Research, Inc., Lawrenceville, NJ (USA)). 1985. NTIS, PC A99/MF A01. Order Number DE88007794/JAW. Contract AC22-83PC60017.

From 2. annual Pittsburgh coal conference; Pittsburgh, PA, USA (16 Sep 1985).

Under a contract with the US Dept. of Energy, Hydrocarbon Research, Inc. (HRI) has been studying a new process based on the low-severity two-stage catalytic ebullated-bed hydroconversion of coal. The objectives of this program have been to study, develop, and demonstrate a new two-stage process on Illinois No. 6 bituminous and Wyodak subbituminous coals with the aim of increasing yields of high-quality distillate, improving hydrogen efficiency and reducing catalyst deactivation rates. This paper describes the observations and analysis of results from a 25-day continuous ebullated-bed bench unit demonstration run on Illinois No. 6 Burning Star bituminous coal, and bench studies on Upper Wyodak (Clovis Point) subbituminous coal. The Illinois No. 6 demonstration run was at constant conditions and the Wyodak runs were at various severities. Considerable improvements have been noted in distillate yield, hydrogen utilization efficiency, product quality, and catalyst activity maintenance. Total C_4-975 F distillate yields in excess of 65 W % M.A.F. coal have been obtained for both coals in a sustained, solvent balanced operation. The efficient hydrogenation conditions in the first-stage reactor are considered the key to the high yields achieved. The two-year program schedule and plans are reviewed and the bench unit results are compared with single-stage processing and with other two-stage processes.

42568 (CONF-850982—, pp 382-390) **Pressure effects on steam pyrolysis of coal.** Abichandani, J.S.; Deradourian, C.; Gannon, R.E.; Stickler, D.B.; Woodroffe, J.A.; Neon, K.G. (Avco Everett Research Lab., Inc., MA (USA)). 1985. NTIS, PC A99/MF A01. Order Number DE88007794/JAW. Contract AC21-81FE05123.

From 2. annual Pittsburgh coal conference; Pittsburgh, PA, USA (16 Sep 1985).

Volatiles produced when pulverized coal is subject to very rapid temperature rise (10^6K/s), can be twice as great as indicated by ASTM methods. The volatiles are released in a matter of milliseconds and if allowed to react with background steam over tens of milliseconds, they reach an equilibrium condition with the products consisting primarily of CO, carbon dioxide, hydrogen and water. Rapid pyrolysis reactions will likely find application in indirect processes. Such processes (e.g., the synthesis of methanol from syngas) generally operate at pressure of 30-35 atmospheres, and it is

recognized that operation of the gasification section of the plant at elevated pressures would save downstream compression costs. High-heating-rate, high-temperature devolatilization experiments are carried out in a 10 liter batch reactor which serves to pyrolyze a suspension of pulverized coal in a mixture of steam and nitrogen. The high heating rate of coal particles is achieved by igniting a stoichiometric mixture of hydrogen and oxygen in nitrogen diluent. A rapid quench sampling system, designed to accept gas and particle sample from the reactor interior for a short interval (4ms), at a prescribed time after initiation of reaction, is used to obtain transient reaction data. At 2400 K, steam to carbon molar ratio of 2, and reaction times greater than 100 ms, an increase in pressure from 4 atm to 45 atm is found to have a small positive effect on the coal carbon conversion. The yields of CO and hydrogen increase correspondingly. The carbon dioxide yield is independent of pressure. From economic considerations these results are of direct importance as an increase in pressure increases the yields of desirable products (CO and hydrogen), without affecting the yield of the undesirable product (carbon dioxide).

42569 (CONF-850982—, pp 413-418) **Interaction of supersolvents with coal.** Stiller, A.H.; Zondlo, J.W.; Mintz, E.; Jagodinski, P.; Leong, C.W. (West Virginia Univ., Morgantown (USA)). 1985. NTIS, PC A99/MF A01. Order Number DE88007794/JAW.

From 2. annual Pittsburgh coal conference; Pittsburgh, PA, USA (16 Sep 1985).

A primary goal of this research is to investigate a group of solvents which are capable of dissolving and removing a large fraction of the organic material in coal from the minerals and fixed carbon matrix. Such a group of solvents must be unreactive under the prevailing conditions for the coal dissolution and they must be capable of solubilizing both polar and nonpolar constituents. One solvent family which the authors have found to meet most closely these criteria are the so-called dipolar aprotic solvents. Specific solvents in the initial work include, but are not limited to, tetramethylurea (TMU), hexamethylphosphoramide (HMPA), and N-methylpyrrolidone (NMP) and dimethylacetamide (DMAA). In this paper the authors report preliminary results of this work on low temperature coal dissolution and upgrading in supersolvents. The results of some initial coal solubility studies are presented first. The second section focuses on the effects of temperature, residence time, and solvent to coal ratio on solubility. In the third section, a preliminary study of catalytic upgrading in the supersolvent systems is discussed. The fourth section reports an initial spectroscopy investigation of HMPA, which hope will contribute to the understanding of the unique solvent properties of this compound in particular and the supersolvent class in general. For convenience here, the authors refer to this group of solvents as supersolvents. Notice in particular, there are no ionizable hydrogens, and the Lewis basicity of the amine is attenuated by the electrophilicity of the carbon on the carbonyl.

42570 (CONF-850982—, pp 419-436) **Development of a coal pyrolysis project in New Mexico.** Robinson, C.W. 1985. NTIS, PC A99/MF A01. Order Number DE88007794/JAW.

From 2. annual Pittsburgh coal conference; Pittsburgh, PA, USA (16 Sep 1985).

From this study the author has concluded that the optimum approach for further expansion of San Juan Basin coal exports should be based on pyrolysis for the generation of char, hydrocarbon liquids (oil), and water; furthermore, these should be transported by existing pipelines in a combined slurry form referred to as CHOWM. This product could be delivered into other Southwest US markets or transported by tanker to Japan for use as a boiler fuel substituting for crude oil. This conclusion is based on: eliminating the need for char/liquid separation; avoiding higher than anticipated hydrotreating costs for the hydrocarbon liquids from pyrolysis; the rheological studies indicating advantages in pipeline transport of CHOWM based on both stability and viscosity factors; and the apparent cost/benefit advantages in using CHOWM as a boiler fuel. Further tests are now planned to confirm this preliminary conclusion that pyrolysis for production of CHOWM represents the most viable approach for further development of San Juan Basin coal.

42571 (CONF-850982—, pp 440-448) **Tennessee Valley Authority's ammonia from coal project: its accomplishments and plans for the future.** Weinhold, J.F.; Waitzman, D.A. (Tennessee Valley Authority, Chattanooga (USA)). 1985. NTIS, PC A99/MF A01. Order Number DE88007794/JAW.

From 2. annual Pittsburgh coal conference; Pittsburgh, PA, USA (16 Sep 1985).

In August 1975, shortly after the first energy crisis, the president of The Fertilizer Institute asked the TVA Board of Directors to develop an alternative to natural gas to produce ammonia. TVA responded to the fertilizer industry request through its National Fertilizer Development Center at Muscle Shoals. A small but modern natural-gas-fed ammonia plant was already in place and could be retrofitted to use synthesis gas from coal. With the completion of the test runs scheduled this summer, TVA will have developed and demonstrated a good, viable alternative for US fertilizer industry to use when the economics are right. In the course of doing this, TVA has also developed a medium-Btu synthesis gas plant that produces $H_2$2 and CO from coal. This is a building block from which methanol, gasoline, medium-Btu fuel gas (and therefore electric power), synthetic natural gas, or a host of other materials can be produced. Current efforts are focused on modifying the facility to produce methanol using once through processes compatible with integrated gasification combined cycle utility operation. By passing the cleaned product gas from a gasification plant through a catalyst system before it is used in the gas turbine, 15 to 20% of the energy can be converted to methanol, a clean storable liquid fuel. The facility will also be available to test other feedstocks, equipment, components, and product slates.

42572 (CONF-850982—, pp 449-462) **Co-processing of coal and heavy oil, a new development for the advancement of coal liquefaction.** Boehm, F.G.; Liron, A. (Canadian Coal Liquefaction Corp., Edmonton, Alberta). 1985. NTIS, PC A99/MF A01. Order Number DE88007794/JAW.

From 2. annual Pittsburgh coal conference; Pittsburgh, PA, USA (16 Sep 1985).

The paper begins by discussing the need for synthetic fuels, the state of the art in coal liquefaction, and areas being studied for the reduction of capital and operating costs in coal liquefaction. The authors then present a co-processing concept for subbituminous coal and heavy oil or bitumens that is being studied in Canada. It is a two-stage process in which carbon monoxide and steam solubilize the coal in the first stage and residues are hydrogenated in the second stage. The paper also looks at the Pyrosol process, which was developed as a two-stage coal liquefaction process, as a possible candidate for co-processing of coal and heavy oil. Typical performance results from the first process are presented. Economic analyses for both processes are given.

42573 (CONF-850982—, pp 463-471) **Fixed-bed gasification of eastern bituminous coal.** Pater, K. Jr. (Morgantown Energy Technology Center, WV (USA)). 1985. NTIS, PC A99/MF A01. Order Number DE88007794/JAW.

From 2. annual Pittsburgh coal conference; Pittsburgh, PA, USA (16 Sep 1985).

The US Dept. of Energy (DOE), Morgantown Energy Technology Center (METC), set out, some years ago, to identify design features which would enable a fixed-bed gasifier to operate on the full range of US coals. In addition, an advanced concept for product gas stream treatment was originated and demonstration of its viability was the major objective of this work. Some further modifications of the gasifier were also validated. This has resulted in an integrated test facility focused on the METC stirred fixed-bed gasifier with both air- and oxygen-blowing capabilities. The system includes a novel dry tar full-flow gas cleanup system that sequentially removes dust, and elemental sulfur in separate manageable effluent streams, thus enhancing further stream treatment, disposal, or recycling usage. Also, water-soluble elements, sodium and potassium in particular, are reduced to trace levels. Sulfur removal is accomplished through a first-of-its-kind pressurized Holmes-Stretford desulfurizer plant that converts the hydrogen sulfide in the gas stream to an elemental sulfur cake while operating directly on the fuel gas. Product gas can be extracted after any stage of cleaning to satisfy a variety of end users. The system has been successfully

demonstrated on a broad spectrum of US coals from western subbituminous through the highly caking eastern bituminous variety. Although this report primarily emphasizes air-blown gasification, oxygen-blown tests were also conducted to enhance and broaden the acquired data base. Complete gasification and gas stream cleanup details and data relevant to processing Pittsburgh seam coals at pressures up to 240 psig are presented herein.

42574 (CONF-850982—, pp 473-478) **ChemCoal process and conceptual plant economics.** Porter, C.R.; Knudson, C.L.; Rindt, J.R. (Carbon Resources, Inc., Wheat Ridge, CO (USA)). 1985. NTIS, PC A99/MF A01. Order Number DE88007794/JAW.

From 2. annual Pittsburgh coal conference; Pittsburgh, PA, USA (16 Sep 1985).

Carbon Resources, Inc. is involved in the development of the ChemCoal Process. Tests have been carried out in batch and semi-batch liquefaction units and in continuous process units. Results from the batch, semi-batch, and continuous process units have been reported. The conceptual plant design and preliminary economics have been projected for Carbon Resources, Inc. This paper briefly reviews the ChemCoal Process and summarizes the preliminary economics.

42575 (CONF-850982—, pp 479-496) **Feasibility study on liquid coal preparation and coal char demineralization.** McCown, F.E.; Im, C.J.; Wolfe, R.A. (United Coal Co., Bristol, VA (USA)). 1985. NTIS, PC A99/MF A01. Order Number DE88007794/JAW.

From 2. annual Pittsburgh coal conference; Pittsburgh, PA, USA (16 Sep 1985).

Even though economics are already in favor of switching from petroleum products to coal, the constraints of ash, combustion equipment, and the solid form of coal have greatly impeded the conversion. The objective of the subject study was to expedite the petroleum-to-coal conversion by reducing the equipment modifications for using a coal based fuel to a bare minimum. By using coal in a liquid form, this objective should be realized. The United Coal method involves the low temperature/pressure conversion of coal to gaseous and char form. The noncondensable gases are used to power the mild gasification unit. Approximately 15% of the gases are condensed to form high quality coal liquids which are subsequently milled/mixed with an equal portion of char via the United Coal Company CWM technology. The resultant 100% coal derived liquid can then be used directly in burners designed for heavy oil. Additional studies were made involving coal and char beneficiation. Methods evaluated included froth flotation, gravity separation, electrostatic separation, magnetic separation, and chemical cleaning. As a direct result of performing research on the subject project for the Dept. of Energy, a totally new procedure was devised to remove sulfur and ash from char. It is termed the gaseous phase, thermally induced, chemical separation method, but is usually referred to as chlorine cleaning, since chlorine was the halogen used in the research tests. However, other halogens could be used, such as fluorine and Freon. Using the new method, ash and sulfur were reduced to essentially zero. These results are lower than those achieved by any other method known. Economics of the process are also discussed.

42576 (CONF-850982—, pp 804-820) **Feasibility demonstration of an impact separator for hot gas cleanup.** Napier, J.C.; Roberts, P.B.; Gildersleeve, R.E. (Solar Turbines Inc., San Diego, CA (USA)). 1985. NTIS, PC A99/MF A01. Order Number DE88007794/JAW.

From 2. annual Pittsburgh coal conference; Pittsburgh, PA, USA (16 Sep 1985).

A feasibility demonstration has been conducted of an impact separator concept for the efficient separation and removal of mineral matter from the exhaust of coal-fired combustion equipment. Operation of the device in both a high temperature slagging mode and a lower temperature dry ash mode was investigated downstream of a bench-scale coal combustion system. The test results showed that efficient removal of slag particles from a high-temperature exhaust stream and the transport of the separated slag to a collection pit could be achieved. The low temperature dry ash operation was also effective although fouling of the impact jet array occurred. Target applications of the device include integration with coal-fired combustion equipment aimed at the retrofit of existing oil-fired industrial steam generators.

42577 (CONF-880725—1) **Upgrading of condensibles from coal devolatilization.** Mrochek, J.E.; Scott, C.D. (Oak Ridge National Lab., TN (USA)). 1988. Contract AC05-84OR21400. 11p. NTIS, PC A03/MF A01; GPO Dep. Order Number DE88013243/JAW.

From Oil shale, tar sands and mild gasification; Morgantown, WV, USA (19 Jul 1988).

This project has emphasized the removal of basic nitrogen-containing compounds from condensible liquids that are by-products of mild coal devolatilization processes. Significant amounts of representative condensible products have been difficult to obtain. Products examined during the course of this project have included liquids from the United Coal Company Research Corporation's mile gasification process development unit (UCCRCMGU) in Bristol, VA; from the KILnGAS commercial module being operated by the Allis-Chalmers Coal Gas Corporation in East Alton, IL; and from the process being tested by SGI International at the Salem Furnace Company in Pittsburgh, PA. The UCCRC MGU is capable of handling up to 1500 lb/d of coal at temperatures up to 1500{degree}F under pressure conditions ranging from atmospheric to a mild vacuum. The KILnGAS commercial module is a 600 ton/d plant and uses a ported and pressurized rotary kiln to produce fuel gas from coal. The SGI system, which is a relatively small, batch-fed, atmospheric pyrolyzer with a nominal operating temperature of 1000{degree}F, and a residence time of 20 min, is capable of feeding 50 lb of coal per batch.

42578 (DOE/MC/21259—2573) **Evaluation of fluidized bed coal gasification present status and future development problems, Task III. Final report.** Shinnar, R.; Avidan, A.I.; Weng, L. (Department of Energy, Morgantown, WV (USA). Morgantown Energy Technology Center). Feb 1988. Contract AC21-84MC21259. 199p. NTIS, PC A 09; 3; GPO Dep. Order Number DE88001075/JAW.

This report summarizes a detailed evaluation of the design potential and present achievements of oxygen-blown fluidized-bed gasifiers for medium BTU production. The main emphasis is on the suitability of such gasifiers for Eastern, bituminous coals, and the results are extended to subbituminous coals. The authors tried to achieve these goals by investigating the kinetic, design, and operating constraints of these gasifiers using suitable models and other techniques.

42579 (DOE/MC/22059—2570-Vol.3) **Revised data book for evaluation of combustion and gasification models: Final report, Volume 3.** Christensen, K.R.; Rasband, M.W.; Smoot, L.D. (Brigham Young Univ., Provo, UT (USA). Combustion Lab.). Oct 1987. Contract AC21-85MC22059. 148p. NTIS, PC A07. Order Number DE88001072/JAW.

During the previous contract (DE-AC21-81MC16518) a major task was to identify, collect and publish detailed experimental data for evaluation of comprehensive gasification/combustion codes. A review of the literature was completed and prospective data were identified for inclusion in this data book in five categories of increasing complexity: (1) non-reacting, gaseous flows (58 cases); (2) non-reacting, particle-laden flows (43 cases); (3) gaseous combustion (34 cases); (4) pulverized coal combustion (57 cases); (5) entrained coal gasification (6 cases). Selection of these data was based on a set of criteria which included data completeness, availability of detailed, digital profiles for several properties (e.g., species concentrations, velocity, temperature) and data accuracy. From these 198 cases, which were referenced in the final report (Vol. III), the data base was reduced to a total of 35 sets of data from 8 laboratories, with at least 3 cases in each category above. For these 35 cases, the measured data, together with geometrical dimensions and test conditions were documented in a uniform tabular format. These data were also stored on a magnetic tape for distribution. During this follow-on contract (DE-AC21-85MC22059), the accuracy of the data was checked and several additional corrections were made. The format for reporting the data (Appendix B) was simplified. Also, a review of additional data sets available from the Combustion Laboratory and other sources was completed. In all, 213 cases from 52 investigators at 18 laboratories were considered

and 37 cases are included in this data book from 22 different investigations at 8 independent laboratories. 81 refs.

42580 **(DOE/PC/80502—T9) Interactive chemistry of coal-petroleum processing: Quarterly report, December 16, 1987-March 15, 1988.** Curtis, C.W.; Guin, J.A.; Tarrer, A.R. (Auburn Univ., AL (USA). Dept. of Chemical Engineering). 1988. Contract FG22-85PC80502. 69p. NTIS, PC A04/MF A01;1; GPO Dep. Order Number DE88008480/JAW.

The key findings are summarized. In the experiments with added elemental sulfur or sulfur containing organic compounds, the reactor walls appeared to be sulfided. The sulfided walls showed catalytic activity for promoting hydrogenation reactions of the model systems. Additional sulfur added to the model systems had different effects depending upon the reaction occurring. Hydrogenation of naphthalene and quinoline were enhanced; deoxygenation of o-cresol was inhibited; and hydrogenation of benzothiophene was not affected. However, the product which required further hydrogenation was ethylbenzene whose hydrogenation was not readily promoted by molybdenum sulfide. Adding excess amounts of sulfur to model systems containing nitrogen bases which poison the MoS_2 catalyst may alleviate the effect of the poison to some extent. Two strong nitrogen bases, quinoline and pyridine severely poisoned the catalytic hydrogenation activity and the denitrogenation selectivity of the in situ generated MoS_2. 22 refs., 2 figs., 28 tabs.

42581 **(DOE/PC/80908—8) Low severity coal conversion by ionic hydrogenation: Report for the period of April-June 1988.** Cheng, J.C.; Larsen, J.W. (Lehigh Univ., Bethlehem, PA (USA). Dept. of Chemistry). 30 Jun 1988. Contract FG22-85PC80908. 10p. NTIS, PC A03/MF A01; 1; GPO Dep. Order Number DE88012458/JAW.

The objectives of this report are: to explore the ionic hydrogenation of low rank coals using $H_2O:BF_3$ as the acid and hydrogen gas as the hydride donor in the presence of catalytic quantities of transition metal complexes to activate hydrogen, and to develop the optimum reaction conditions. A variety of ionic hydrogenation systems was screened using two test compounds in the search for effective acid/H_2/catalyst combinations. A new ionic hydrogenation system using $H_2O:BF_3/H_2/(CH_3CN)_2PtCl_2$ was found to hydrogenate aromatics/polynuclear aromatics (PNAs) and to cleave C-O bonds. The reaction products were characterized using standard, appropriate techniques such as NMR, gas chromatography, mass spectrometry, and elemental analyses. The $H_2O:BF_3/H_2/(MeCN)_2PtCl_2$ system was applied to Wyodak coal in an attempt to develop efficient, near room temperature coal conversion chemistry. 10 refs., 3 tabs.

42582 **(EPRI-ER—5709-SR) Proceedings: First annual workshop and biologic processing of coal.** (Electric Power Research Inst., Palo Alto, CA (USA)). Mar 1988. 242p. (CONF-8702135—). Research Reports Center, Box 50490, Palo Alto, CA 94303;1. Order Number TI88008476/JAW.

From 1. annual workshop on biologic processing of coal; Monterey, CA, USA (17 Feb 1987).

Speakers at EPRI's first annual workshop on the biologic processing of coal discussed several promising methods for improving use of lower-quality coal, including microbial solubilization, desulfurization, gasification, and demetalization. The workshop pointed out the need for collaboration and greater market awareness within the research community in its investigation of biologic processing. Projects are processed separately for the data bases.

42583 **(EUR—11128-EN,FR) Syntheais gas production in the blast furnace: feasibility study - demonstration project.** (Commission of the European Communities, Luxembourg). 1987. 157p. European Community Information Service, 2100 M St., NW, Suite 707, Washington, DC 20037.

This is the final report of a feasibility study carried out in the framework of the European Commission Energy Demonstration Programme. The aim of the study was twofold: to determine whether the conversion of a blast-furnace into a gas generator is technically feasible, and to evaluate the approximate cost price of the synthesis gas produced. It has been shown that the existing technique of injecting coal at the level of the tuyeres is directly applicable to coal gasification in the blast-furnace. Serveral operating scenarios have been studied, particularly in the light of the need to maintain an efficient circulation of fluids in the blast-furnace. From the economic viewpoint, the principal advantage of the process is that the capital investment required to convert the blast-furnace into a coal gasifier is relatively small compared to the cost of a conventional gas generator. The former has been estimated at around 20 millions ECU for a production capacity of 80,000 Nm^3 per hour (CO H_2). If the estimates are confirmed by large-scale testing, the cost price of the gas will be 60% of the cost price, per gigajoule, of gas from normal coal gasification, 67% of the price of gas from the reforming of natural gas and 64% of the price of gas from liquid hydrocarbons. A large part of the study deals with the analysis of the potential end uses of the huge quantities of syngas that would have to be used should this technology be applied.

42584 (EUR—11191, pp 5-118) **Indirect liquefaction.** Thyrion, F.C. (Louvain University, Louvain-la-Neuve (Belgium)). 1987. European Community Information Service, 2100 M St., NW, Suite 707, Washington, DC 20037.

In Synthetic fuels from coal: status of the technology.

Part I of the report contains four chapters on the development of processes for the indirect conversion of coal into liquids. The author discusses in detail the Fischer-Tropsch Synthesis and the Mobil Process. The commercial F-T plants in South Africa are described, and there is an overview of syngas-based fuel production.

42585 (EUR—11191, pp 259-338) **Coprocessing (coprocessing with oil).** Oelert, H. (Universitaet Clausthal (Germany, F.R.)). 1987. European Community Information Service, 2100 M St., NW, Suite 707, Washington, DC 20037.

In Synthetic fuels from coal: status of the technology.

Part 4 of the report deals with coprocessing which refers to the processing of coal and oil simultaneously with the objective of liquefying the coal and upgrading the oil. The author discusses in detail the background technology and the development of the various processes in this field. A discussion of basic research and development in the technology is included.

42586 (EUR—11191, pp 119-197) **Single-stage direct coal liquefaction.** Romey, I.F.W. (Bergbau-Forschung GmbH (Germany, F.R.)). 1987. European Community Information Service, 2100 M St., NW, Suite 707, Washington, DC 20037.

In Synthetic fuels from coal: status of the technology.

Part 2 of the report contains 4 chapters which review the current status in the field of single-stage liquefaction. Single-stage direct liquefaction processes had been developed during the last two decades in many countries including USA, FRG, USSR, Japan, Australia and others. To compare the different developments worldwide, the review deals mainly with those developments demonstrated not only in PDU but also in pilot plant-scale with about 50-600 t/d coal input. Basic research work in single-stage coal liquefaction is described briefly.

42587 (EUR—11191, pp 199-258) **Direct liquefaction (two-stage processes).** Moore, S.A.; Kimber, G.M.; Whitehead, J.C. (British Coal, Cheltenham (United Kingdom). Coal Research Establishment). 1987. European Community Information Service, 2100 M St., NW, Suite 707, Washington, DC 20037.

In Synthetic fuels from coal: status of the technology.

Part 3 of the report reviews processes in the field of two-stage direct liquefaction. A 'two-stage direct coal liquefaction' is defined by this review as a process designed to give distillate products via two reactors or reactor trains in series. The primary function of the first stage is to solubilise the coal and it is operated either without catalyst or with only a low activity disposable catalyst. The heavy coal liquids produced in this way are hydrotreated in the second stage in the presence of a high activity catalyst to produce additional distillate. Related research and development in this field is provided.

42588 (NERDDP-CS—87-18) Assessment of coal hydroliquefaction R & D supported under the NERDD program. McKee, D. (National Energy Research, Development and Demonstration Council, Canberra (Australia)). Dec 1986. 398p. Dept. of Resources and Energy, GPO Box 858, Canberra, ACT 2601, Australia.

This study has as its main emphasis a critical assessment of hydroliquefaction R & D projects funded under the National Energy Research Development and Demonstration Program (NERDDP), to which 14.8 million dollars were committed from the inception of the program in 1978 to December 1985. The overall objective of the study is to report on the progress and status of coal hydroliquefaction R & D in Australia, based in particular on a detailed review of NERDDP projects, and to place this in perspective with regard to developments overseas.

42589 (NERDDP-EG—87-649) Continuous coal hydrogenation process and products. Cookson, D.J.; Smith, B.E. (National Energy Research, Development and Demonstration Council, Canberra (Australia)). Dec 1985. 667p. Dept. of Resources and Energy, GPO Box 858, Canberra, ACT 2601, Australia.

This report describes the work carried out during the period July 1983 to December 1985 in support of the NERDDP funded project 'Continuous Coal Hydrogenation Processes and Products'. Major achievements and conclusions are summarized in Part 1 of the report. Part 2 describes work related to the production of syncrudes via primary coal hydroliquefaction. In part 3, the production of transport fuels from coal syncrudes is discussed. The development of NMR methods for product analysis and process characterization are described in part 4.

42590 (NERDDP-EG—87-658) Coal characterisation by vitrinite and inertinite fluorescence. Diessel, C.; McHugh, E.; Brown, K. (National Energy Research, Development and Demonstration Council, Canberra (Australia)). Dec 1986. 93p. Dept. of Resources and Energy, GPO Box 858, Canberra, ACT 2601, Australia.

Ten Australian coals of Permian age and twenty Carboniferous coals from the Ruhr district of Germany have been carbonised, and both feed coal and coke samples have been subjected to petrographic and other laboratory analyses. Mass balance calculations demonstrate that inertinite dissociates thermally into four components: 1. Gas and liquor, 2. fused coke matrix (FCM); 3. partly fused coke inclusions (PFCI); and 4. unfused coke inclusions (UFCI). Fluorescence intensity ranges have been determined for the three solid categories, and analysis procedures have been suggested by which the fusibility of coal components can be assessed without reference to their petrographic character.

42591 (NP—8770263) Theoretical and experimental investigation for developing a mathematical model of coking. Suessmeir, T. (Technische Univ. Clausthal, Clausthal-Zellerfeld (Germany, F.R.). Fakultaet fuer Bergbau, Huettenwesen und Maschinenwesen). 20 Dec 1985. 122p. (In German). NTIS (US Sales Only), PC A06/MF A01. Order Number DE88770263/JAW.

In this work, a mathematical model for describing the temperature field during the heating of heaps of coke and coal was produced. The model developed was checked by experimental investigations in an experimental reactor and was confirmed with sufficient accuracy. The mathematical modelling of the evaporation and condensation processes was taken into account in part of the model. A part model taking material transport of the volatile parts also had to be produced. The temperature fields measured in one plane during heating of the coke and during coking of various coals could be satisfactorily reproduced with the one-dimensional mathematical model shown here, based on the expanded Fourier equation. This one-dimensional model for describing the heat and material transport was then expanded to a simplified two-dimensional model. (orig./RB)

42592 Gasification: key to chemicals from coal. Wilson, J.S.; Halow, J.; Ghate, M.R. (Morgantown Energy Technology Center, WV (USA)). *CHEMTECH;* **18**: No. 2, 123-128(Feb 1988).

Gasification technologies fall into three major categories: fixed or moving bed, fluidized-bed and entrained-flow. This article presents the highlights of the major past and present projects in this technological area. The problems of contaminant removal are common to both power generation and synthesis gas producing systems. 3 refs., 3 figs., 3 tabs.

42593 Modeling and experimental studies on devolatilization yields from a bituminous coal. Parikh, R.S.; Mahalingam, R. (Dept. of Chemical Engineering, Washington State Univ., Pullman, WA (US)). *Industrial and Engineering Chemistry Research;* **26**: No. 11, 2378-2384(Nov 1987).

A laboratory-scale fixed bed reactor was set up to simulate conditions existing in the devolatilization zone of an air-blow, Lurgi-type, fixed bed coal gasifier. The effects of temperature (350-550°C) and particle size (1-9 mm) on the devolatilization behavior of a bituminous coal in such a reactor were studied. The feed gas composition was chosen to approximate that entering the devolatilization zone from the gasification zone below in a commercial-scale fixed bed reactor. Similar studies were also carried out on a thermogravimetric analysis (TGA) reactor, for purposes of comparison. A semitheoretical model, describing the transport of the tar and gas species to the surface of the particle, and the subsequent evolution of these, is developed. The model takes into account the softening characteristics of bituminous coals upon heating. The volatiles yield predicted by the model is next compared with the experimental results, and the agreement appears quite good.

0105 By-products

REFER ALSO TO CITATION(S) 42560, 42656

0106 Properties

REFER ALSO TO CITATION(S) 42552, 42553, 42556, 42560, 42577, 42581, 42590, 42632, 42670, 42673, 42676, 42702, 42703, 42704

42594 (CONF-850982—, pp 273-285) Electron microprobe characterization of chlorine and sulfur in Illinois basin coals. Kaegi, D.D.; Hamling, J.W. (Inland Steel Research Labs., Chicago, IN (USA)). 1985. NTIS, PC A99/MF A01. Order Number DE88007794/JAW.

From 2. annual Pittsburgh coal conference; Pittsburgh, PA, USA (16 Sep 1985).

Chlorine content has long been considered indicative of a coal's fouling tendencies when used in coal-fired boilers. However, more recently it has been established that boiler corrosion and fireside deposits mainly occur due to sodium and sulfur in the coal. Thus, the earlier relationship between chlorine content and fouling tendency was not a cause-and-effect relationship, but was an empirical relationship dependent upon the occurrence of the chlorine in association with alkalies in the coal. This view appears relevant to understanding why years of use of high chlorine (about 0.60%) Illinois No. 6 seam coal at Inland Steel Company's power plant has produced no significant corrosion or fouling. Study of the mode of occurrence of chlorine in Inland's Illinois No. 6 seam coal via leaching experiments, elemental mass balance calculations, and electron microprobe analyses showed that most, if not all, of the chlorine in this specific coal is not associated with alkalies. It was of interest to learn whether the lack of inorganic chlorine is a common mode of occurrence. Samples of Illinois No. 5, and No. 6 coals and Indiana VII coal were studied by electron microprobe analysis as well as by the ASTM proximate analysis. Procedures and results are given.

42595 (CONF-850982—, pp 306-312) Predicting coal quality. Martino, F.; Latimer, S.; Chopra, I. (Pennsylvania Electric Co., Johnstown (USA)). 1985. NTIS, PC A99/MF A01. Order Number DE88007794/JAW.

From 2. annual Pittsburgh coal conference; Pittsburgh, PA, USA (16 Sep 1985).

A proper and accurate characterization of the in and out-of-seam coal properties is necessary as basic input to various operating control processes such as coal cleaning, blending, and utilization.

Therefore, accurate prediction of in-seam coal qualities with a measure of a reliability is one important link in the overall processes control chain. The Homer City Owners developed a short-term prediction modeling system (STPM) specifically designed for the purpose of aiding them in understanding coal seam variability and complying with environmental emission standards. This paper presents some results of the Homer City Owners' EPA Coal Reserve Characterization Program (CRC) comparing actual as-received coal quality with the STPM model predictions of coal received from the Homer City No. 1 mine and the Lucerne 6, 8, and 9 mines actively operating thirty continuous mining machines daily in the Upper and Lower Freeport coal seams. But, before the STPM models can be used in any of these mines, a basic geostatistical study was performed on each mining reserve to obtain a usable variogram model for each of the coal quality parameters modeled. Results from this model are given.

42596 (CONF-850982—, pp 313) **Geologic processes affecting the quality of the Upper Freeport coal bed, West-Central Pennsylvania.** Stanton, R.W.; Cecil, C.B.; Pierce, B.S.; Ruppert, L.F.; Dulong, F.T. (Geological Survey, Reston, VA (USA)). 1985. NTIS, PC A99/MF A01. Order Number DE88007794/JAW.

From 2. annual Pittsburgh coal conference; Pittsburgh, PA, USA (16 Sep 1985).

The number or types of origins of the components of a coal bed cannot be determined from its bulk composition. Minerals such as quartz, calcite, and pyrite as well as macerals such as vitrinite can originate from a variety of processes that result from different depositional conditions. The Upper Freeport coal bed was studied and characterized by sampling and analyzing its mappable subunits (facies) over a 120-sq mi area in west-central Pennsylvania. The study was based on field description of mine faces and description of x-ray radiographs of core. Where thickest, the coal bed averages 83 inches and contains 8 to 10 facies; in other areas, the bed averages about 48 inches and is generally composed of 4 facies. Results are summarized.

42597 (CONF-850982—, pp 344-355) **Adaptation of characterization methods of coal stockpiles to assure consistency in quality for synthetic fuel processes.** McConnell, O.T. (L. Robert Kimball and Associates, Ebensburg, PA (USA)). 1985. NTIS, PC A99/MF A01. Order Number DE88007794/JAW.

From 2. annual Pittsburgh coal conference; Pittsburgh, PA, USA (16 Sep 1985).

An inventory process to determine on-site tonnages of coal requires a volume determination and density determination. This paper was limited to on-site considerations relative to quantity and quality characteristics of a coal stockpile. There are many existing standards by nationally recognized organizations which guide the sampling and testing procedures. Some considerations of pile quality and quantity cannot be measured according to any well defined standard. This issue is more evident in the area of density determinations of stockpiles. The qualitative analysis of coal is relatively well defined and procedures generally accepted as per existing standards. These procedures are not always clearcut especially in the area of sample collection utilizing on-site drilling techniques. The problem associated with obtaining samples during a drilling program are that of obtaining sufficient representative samples which allow the top size of coal on the pile to be included in the analysis. In brief, sampling techniques utilizing drilling methods should anticipate a possible bias in subsequent test results. As of this time, density testing procedures to identify stockpile densities are not guided by any approved standard from a national organization. Density test procedures being conducted represent individual techniques developed by engineering firms and various utilities who conduct their own on-site testing. A tentative draft of a density test standard by a national organization is being developed at this time. The standard specifically defines procedures associated with nuclear backscatter depth-density determinations.

42598 (CONF-850982—, pp 405-412) **Investigation of the structures of catalytic species of interest in coal gasification.** Huffman, G.P.; Higgins, F.E.; Lytle, F.W.; Greegor, R.B.; Jenkins, R.G. (Steel Technology Center, Monroeville, PA (USA)). 1985. NTIS, PC A99/MF A01. Order Number DE88007794/JAW.

From 2. annual Pittsburgh coal conference; Pittsburgh, PA, USA (16 Sep 1985).

The importance of the catalytic reactions of alkalies and alkaline earths during the gasification of coal chars and other carbon forms is well known and has been extensively studied. Numerous proposals exist regarding the sequences of reactions involving such catalysts that result in char gasification. In the current paper, the authors present the initial results of a program aimed at determining the structure of alkali and alkaline earth catalysts in coal and related char samples, before, after, and during gasification. The principal investigative techniques are x-ray absorption fine structure spectroscopy, often referred to as EXAFS spectroscopy, and computer-controlled scanning electron microscopy (CCSEM). Our initial investigations have dealt primarily with determining the structure of both calcium and potassium as they occur naturally in coal as a function of coal rank, of potassium in a suite of K-enriched cokes or chars, and of calcium in chars produced from lignites subjected to a calcium cation exchange treatment.

42599 (CONF-850982—, pp 499-512) **Experimental and analytical study of coal slurry viscosity changes due to changing coal mass fractions, temperature, and particle size.** Beans, E.W.; Masiulaniec, K.C.; Lamarca, W. (Univ. of Toledo, OH (USA)). 1985. NTIS, PC A99/MF A01. Order Number DE88007794/JAW.

From 2. annual Pittsburgh coal conference; Pittsburgh, PA, USA (16 Sep 1985).

Experimental results are presented of shear stress vs. velocity gradient for coal-oil slurry mixtures, using mass fraction, particle size, and temperature as independent variables. Particle sizes varied from 74-420 micrometers, mass fraction varied from 0.00 to 0.45, and temperatures varied from 20-50 C. The experimental results show the slurry behaves in a Newtonian fashion over the range of independent variables tested. A theoretical analysis is presented based on the fundamentals of particle packing theory and continuity. The models created by the theoretical analysis agree well with the experimental results. The analysis predicts viscosity variation curves within which the experimental data lies.

42600 (CONF-850982—, pp 513-523) **Flow studies of coal water fuels in both low and high shear rate regimes.** Dooher, J.; Cote, D.; Dazzi, C.; Malicki, N.; Wright, D. (Adelphi Univ., Garden City, NY (USA)). 1985. NTIS, PC A99/MF A01. Order Number DE88007794/JAW.

From 2. annual Pittsburgh coal conference; Pittsburgh, PA, USA (16 Sep 1985).

The research presented was part of an investigation funded by: the Dept. of Energy, Electric Power Research Institute, Empire State Electric Energy Research Corporation, Florida Power and Light Company, New York Power Authority, New York State Energy Research and Development Authority. One of the primary objectives of this program was to examine the rheological behavior of six commercially available CWF in both low and high shear regions. The focus of this paper is on two highly loaded CWF (> 67 wt% coal), and one moderately loaded CWF (~ 54 wt% coal). Measuring methods and test results are given, and results are discussed.

42601 (CONF-850982—, pp 670-688) **Pilot scale evaluation of the influence of mineral matter on boiler performance.** Pohl, J.H. (Energy and Environmental Research Corp., Irvine, CA (USA)). 1985. NTIS, PC A99/MF A01. Order Number DE88007794/JAW.

From 2. annual Pittsburgh coal conference; Pittsburgh, PA, USA (16 Sep 1985).

The performance of fuels were evaluated in a nominal 1 x 10^6 Btu/hr pilot scale furnace. The relative slagging, fouling, and electrostatic precipitator performance were determined and correlated with the properties of the fuels. Slagging was found to correlate with K_2O, S and ash in the fuel; fouling with $Na_2O/10^6$ Btu

and the initial oxidizing deformation temperature and ESP collection efficiency with the mass of particles less than 2 microns in aerodynamic diameter. In addition, the relative erosion, heat transfer and disposal problems were determined for a number of fuels, but correlations were not developed.

42602 **(CONF-880286—1) New calculational method for deducing the complex chemistry of coal ash deposits.** Sinha, S.; Natesan, K.; Blander, M. (Argonne National Lab., IL (USA)). 1988. Contract W-31-109-ENG-38. 10p. NTIS, PC A02/MF A01; 1; GPO Dep. Order Number DE88011979/JAW.

From Mineral mattery and ash deposition from coal conference; Santa Barbara, CA, USA (21 Feb 1988).

In this paper, the authors use a new calculational method, based on geometric programming, for computing the large number of condensed and gaseous products of coal combustion. A silica saturated liquid silicate-sulfate solution is formed from Illinois No. 6 coal under oxidizing conditions and, under some nonequilibrium conditions, is table to temperatures lower than at equilibrium. The liquid phase is an important factor in ash agglomeration, and the nonequilibrium aspects of its formation will require careful examination in coupled experimental-calculational studies in order to fully define the chemistry, the tendency to agglomerate, and the corrosivity of combustion products.

42603 **(DOE/PC/90504—T6) Configurational diffusion of coal macromolecules: Quarterly progress report, March 16, 1988-June 15, 1988.** Guin, J.A.; Curtis, C.W.; Tarrer, A.R. (Auburn Univ., AL (USA). Coal Conversion Lab.). 1988. Contract FG22-86PC90504. 21p. NTIS, PC A03/MF A01;1; GPO Dep. Order Number DE88012177/JAW.

The phenomenon of hindered diffusion of coal macromolecules in an idealized porous media is being investigated. This quarter work has centered on the evaluation of the boundary layer resistance with an organic system. N-octane (as solute) and n-decane (as solvent) were used in this study. From the experimental results, it was found that the empirical equation developed from the sucrose diffusion experiments could be applied to any system to evaluate the boundary layer resistance. The best empirical equation which described the boundary layer behavior in our diffusion cell was developed from a plot of Log (Sh) vs. Log (Re) using all the diffusion data. 4 refs., 4 figs., 5 tabs.

42604 **(DOE/PC/90960—7) Rheology of high concentration polymodal multiphase flow: Quarterly report.** Probstein, R.F. (Massachusetts Inst. of Tech., Cambridge (USA)). Apr 1988. Contract FG22-86PC90960. 7p. NTIS, PC A02/MF A01; GPO Dep. Order Number DE88008450/JAW.

Viscosity experiments run at MIT on bimodal coal slurries have revealed the fact that the shear-dependent vicosity of coal-water mixture is solely influenced by the presence of micron size colloidal particles and that the behavior of the coarse particles is independent of the applied shear rate. It has been observed that at relatively high coarse particle volume fractions {phi}/sub c/, the colloidal fraction consisting of liquid plus colloidal particles, which was squeezed out from between the coarse particles experienced a higher shear rate than the externally applied value in the viscometer. Therefore, the shear rate on the colloidal fraction had to be modified to a higher "effective" value to take into account the effect of high coarse particle volume fractions. This behavior was also observed with truly polymodal high density coal-water slurries supplied to us by PETC. An effort was made previously to theoretically derive the shear correction factor. However, it was noted that the basic postulate could not be justified uniquely on either physical or mathematical grounds. During this last quarterly reporting period, a new expression has been obtained for the shear correction factor using physically and mathematically sound arguments and its derivation is given in this report. 4 refs., 1 fig.

42605 **(MSL—87-117(IR)) The improvements in peak resolution and in reproducibility of spectrochronograms of different sulphur forms in coals by addition of silica powder to coal sample.** Moon, K.S.; Sirois, L.L. (Canada Centre for Mineral and Energy Technology, Ottawa, Ontario). Aug 1987. 15p. CANMET, Ottawa, Ontario.

In an effort to improve the spectrochronograms of different sulphur forms in coals during analysis in the new CANMET Sulphur Form Analyzer, a new sample preparation technique was developed. Coal samples were mixed with a number of solid matrix materials in an attempt to control the local reaction temperature. Mixing inert silica and coal samples resulted in a dramatic improvement in spectrochronogram resolution and reproducibility. 4 refs., 6 figs., 3 tabs.

42606 **(NERDDP-EG—87-643) Laser induced fluorescence of coal.** Eberhardt, J.; Haub, J.; Death, D. (National Energy Research, Development and Demonstration Council, Canberra (Australia)). Dec 1986. 48p. Dept. of Resources and Energy, GPO Box 858, Canberra, ACT 2601, Australia.

The new technique of laser excited fluorescence of bulk coal was developed using an ultraviolet nitrogen laser. Unlike previous work the fluorescence of large areas was analysed rather than that of individual macerals. Samples of 61 different coals ranging from brown coal to semi-anthracite were studied. The fluorescence intensity had a 100 fold range across the suite and correlated well with the percentage of volatile matter and oxygen, the atomic H/C ratio, vitrinite reflectance and other parameters. Percent ash, sulphur and nitogen correlated poorly. The method is capable of considerable improvement and is suited to bore core scanning, on-line conveyor measurements and laboratory use.

42607 **(NERDDP-EG—87-652) The abrasiveness of coal.** Sligar, J. (National Energy Research, Development and Demonstration Council, Canberra (Australia)). Jun 1986. 83p. Dept. of Resources and Energy, GPO Box 858, Canberra, ACT 2601, Australia.

This project was concerned with the measurement, comparisons and prediction of the abrasiveness of coal. It was also concerned with the measurement and prediction of actual component part wear in coal pulverizers grinding Australian coals. Power Station coal pulverizers were subjected to a normal wear cycle. Major components were weighed before and after to determine actual weight loss. Representative coal samples taken during the mill cycle were analysed in detail including various measures of coal abrasiveness. Poor correlations were observed between abrasiveness results for coals tested. Abrasiveness measured by one test cannot therefore be converted to another scale. In an attempt to predict abrasiveness excellent correlations were obtained. These were based upon considering abrasiveness to be an additive function made up of factors representing proportion and particle size distribution of every abrasive component. Correlations were excellent with synthetic samples and poor with natural samples of coal. Satisfactory correlations were found between full scale pulverizer wear and coal abrasiveness results. The preferred abrasiveness test was BS 1016:19, 1980. This allowed prediction of coal pulverizer life between overhauls from abrasiveness test values.

42608 **Application of inverse gas chromatography to fluidity studies.** Winans, R.E.; Neill, P.H. (Argonne National Lab., IL (USA). Chemistry Division). pp 1-11, Paper R8.3 of Coal research conference. Volume 1, sessions R1 - R19. Wellington, New Zealand; Coal Research Association of New Zealand (1987). (CONF-871193—).

From 2. coal research conference; Wellington, New Zealand (2 Nov 1987).

A new method has been developed, Inverse Gas Chromatography (IGC), for evaluating coal fluidity at elevated temperatures. This technique is being used to follow changes in coal structure which affect the coal's fluidity. In IGC, which is used to study polymers, the retention of a probe molecule on the coal surface in a flowing gas system is followed as a function temperature. The relative size of changes in the structure and the temperatures at which these changes occur can be measured very accurately and reproducibility with this technique. The results compare favorably with more traditional methods of measuring coal fluidity while, in addition, providing data which can be used to understand the underlying chemical and physical changes in structure with weathering. 23 refs., 6 figs., 2 tabs.

42609 **Chemical and physical structure of coals.** Winans, R.E.; McBeth, R.L.; Scott, R.G.; Thiyagarajan, P.; Botto, R.E.; Hayatsu, R. (Argonne National Lab., IL (USA). Chemistry Division). pp 1-14, Paper R13.1 of Coal research conference. Volume 1, sessions R1 - R19. Wellington, New Zealand; Coal Research Association of New Zealand (1987). (CONF-871193—).

From 2. coal research conference; Wellington, New Zealand (2 Nov 1987).

New information on the chemical and physical structure of coals and separated coal macerals strongly suggests that polycyclic aromatics do not dominate the aromatic structure except in the very high rank coals and in inertinites. Two very different approaches have led to these conclusions. First, a very mild, selective oxidation method has been used to break down the coal macromolecular structure into molecules which can be readily characterized. The products are dominated by single ring aromatics. Second, small-angle neutron scattering has been used to study solvent swollen coals. There is no evidence from the data for a layered structure, instead long tubular pores are being formed as an apparent result of changes in the hydrogen-bonding in the matrix. These results have important implications in better understanding coal reactivity, especially in milder processes. 20 refs., 8 figs., 1 tab.

0108 Waste Management

REFER ALSO TO CITATION(S) 42601, 42628, 42645, 42646, 42670

42610 **(ANL/CNSV-TM—203) Analysis of gas flows in a new method for carbon dioxide recovery.** Berry, G.F.; Wang, C.S.; Dennis, C.B.; Wolsky, A.M. (Argonne National Lab., IL (USA)). Apr 1988. Contract W-31109-ENG-38. 41p. NTIS, PC A03/MF A01; 1; GPO Dep. Order Number DE88012662/JAW.

The relative size and composition of gas streams concomitant with a new method of carbon dioxide recovery are described and related to each other. This is done for two variations: dry recycle and wet recycle. Calculations performed under the different assumptions of complete combustion and chemical equilibrium are compared. The following fuels are considered: two hypothetical fuels, CH/sub 0. 4/and CH/sub 0.8/; methane, CH_4; Wyodak coal, CN/sub 0. 013/H/sub 1.675/O/sub 0.606/S/sub 0.004/; and Black Thunder coal, CN/sub 0.019/H/sub 1.599/O/sub 0.539/S/sub 0.003/. The purity of carbon dioxide from the system exit, the recycle fraction of combustion products, the oxygen concentration at the furnace inlet and outlet, and the excess oxygen at the furnace inlet are investigated. 6 refs., 6 figs., 20 tabs.

42611 (CONF-850982—, pp 158-163) **In-duct application of dry flue gas desulfurization a cost effective retrofit technology for reduction of sulfur emissions.** Shilling, N.Z. (General Electric Environmental Services, Inc., Lebanon, PA (USA)). 1985. NTIS, PC A99/MF A01. Order Number DE88007794/JAW.

From 2. annual Pittsburgh coal conference; Pittsburgh, PA, USA (16 Sep 1985).

The recent promulgation of tall stack regulations and future acid rain legislation will require development of compliance strategies for older power plants. In such situations, low costmedium efficiency flue gas desulfurization methods will be useful to extend the life of power plants. This paper reviews the justifying technical and economic reasons for application of atomization technology developed for DEGD in existing duct work. Critical requirements for successful application include (1) adequate mixing for moderate removal efficiency, (2) sufficient residence time for non-wetting product prior to precipitator or baghouse and (3) sufficient duct cross-section dimensions to prevent deposition of product before drying. The duct work in many older power plants previously retrofitted to meet NSPS particulate standards meet criteria 2 and 3. A pilot program has been proposed at 12 ME/sub e/ scale for the DOE Acid Rain Precurser Control Program. This pilot, to be installed on the AEP system at Ohio Power Company's Muskingum River No. 5 power plant would be used to identify suitable duct work configurations and adaptations for in-duct scrubbing.

42612 (CONF-850982—, pp 165) **Copper oxide moving bed for removal of NO/sub x/, SO/sub x/, and particulates from flue gas.** Stelman, D.; Ampaya, J.P.; Heredy, L.A.; Kohl, A.L.; Newcomb, J.C. (Rockwell International Corp., Canoga Park, CA (USA)). 1985. NTIS, PC A99/MF A01. Order Number DE88007794/JAW. Contract AC22-83PC60262.

From 2. annual Pittsburgh coal conference; Pittsburgh, PA, USA (16 Sep 1985).

The objective of this work is to test and evaluate a single-stage process for simultaneously removing 90% of the NO/sub x/, 90% of the SO/sub x/, and 99.9% of the particulates from flue gas. The process utilizes a novel contractorfilter with a moving bed of copper oxide absorber catalyst. At 400°C, NO/sub x/ is catalytically reduced to N_2 by adding NH_3 to the flue gas, and SO/sub x/ is absorbed by the copper oxide. The same contractorfilter also removes the particulates from the flue gas. The absorber catalyst is regenerated by reacting the copper sulfate formed with a reducing gas such as hydrogen or methane and is then reused in the process. The approach involved preliminary tests in a fixed bed to select and characterize candidate catalysts and to determine the appropriate design parameters for a moving-bed test unit. Subsequently, parametric tests were performed in the moving-bed test unit to determine the important design parameters and to gather the data that would be required for a process evaluation.

42613 (CONF-850982—, pp 166-176) **Electrochemical flue gas desulfurization.** Scott, K.; Winnick, J. (Georgia Institute of Technology, Atlanta (USA)). 1985. NTIS, PC A99/MF A01. Order Number DE88007794/JAW.

From 2. annual Pittsburgh coal conference; Pittsburgh, PA, USA (16 Sep 1985).

The electrochemical reactions in a pyrosulfate melt have been studied. The experimental work focused on testing possible electrolytes for use in a flue-gas desulfurization cell operating at a much lower temperature than was previously possible. In a two-compartment gas-tight cell, the analysis of the cathode effluent stream provided vital information on the reactions taking place. In pure potassium pyrosulfate, no removal of SO_2 with applied current took place. Rather, SO_2 was produced, eliminating pure $K_2S_2O_7$ as a candidate electrolyte. However, in 1% V_2O_5 - 99% $K_2S_2O_7$ cathodic SO_2 removal increased with current until the process was limited by the rate of SO_2 transfer from the flue gas bubbles. Addition of SO_4^{2-} further enhances the SO_2 removal rate and future work will involve $S_2O_7^{2-}/SO_4^{2-}/V_2O_5$ combinations. A cathodic reaction scheme consistent with our results and those of other workers has been presented.

42614 (CONF-850982—, pp 177-196) **SOXAL flue gas desulfurization process - results of lab and pilot studies.** Mani, K.N.; Chlanda, F.P. (Allied Corp., Mt. Bethel, NJ (USA)). 1985. NTIS, PC A99/MF A01. Order Number DE88007794/JAW.

From 2. annual Pittsburgh coal conference; Pittsburgh, PA, USA (16 Sep 1985).

The SOXAL process is a membrane based regenerative flue gas desulfurization process which recovers sulfur values in the form of a concentrated sulfur dioxide stream. The process uses a high pH sodium solution as a scrubbing medium to remove the sulfur oxide from the flue gas. The product solution from the absorber is regenerated via an electrically driven process that uses water splitting membranes to convert the bisulfite salt to the original sulfite and hydroxide which are recycled to the absorber and an aqueous solution of SO_2 which is readily stripped to recover concentrated sulfur dioxide. The SOXAL process and the associated membrane technology have been under development at Allied Corporation and are presently being commercialized by its Aquatech Systems Business Unit. This paper describes the process and the pilot plant test procedures and discusses the results of the pilot study and recent lab studies undertaken to improve the process.

42615 (CONF-850982—, pp 199-210) **Dolomitic lime process for retrofit FGD applications.** Abrams, J.Z.; Zaczek, S.J. (Bechtel Group, Inc., San Francisco, CA (USA)). 1985. NTIS, PC A99/MF A01. Order Number DE88007794/JAW.

From 2. annual Pittsburgh coal conference; Pittsburgh, PA, USA (16 Sep 1985).

The information in this paper is directed to those concerned with controlling SO_2 emissions from power plants, and particularly with retrofitting controls onto existing plants. The paper describes an FGD system based on the dolomitic lime process and the scrubber design that have proved successful at the Colstrip Plant in eastern Montana. A single scrubber vessel sized to treat all the gas from a 350 MWe coal fired unit combines the functions of prequenching, absorption, washing, mist elimination, and recycle storage. Downflow injection of gas along the vessel center line and regulation of gas flow by the wash tray make the gas velocity uniform and permit scaling up to this large size. A high concentration of dissolved alkalinity in the scrubbing slurry provides rapid absorption and permits low L/G - 40 gal/1000 acf - when coal with 2.5% sulfur is burned. Complete oxidation of sulfite makes gypsum of wallboard quality and the process can discharge clarified liquor low in COD if necessary to control chlorides. Since only the single scrubber vessel and the recycle pumps must be located close to the back end of the boiler, the system is particularly well suited for retrofit applications.

42616 (CONF-850982—, pp 211-222) **Burn coal and easily remove SO_2 & No/sub x/.** Frank, N.W.; Geary, C.H.; Miller, G.A. (Ebara International Corp., Greensburg, PA (USA)). 1985. NTIS, PC A99/MF A01. Order Number DE88007794/JAW.

From 2. annual Pittsburgh coal conference; Pittsburgh, PA, USA (16 Sep 1985).

An alternative to existing desulfurization systems is the Ebara Electron Beam Flue Gas Treatment Process (E-Beam PGT). Utilizing a method of simultaneous desulfurization and denitrification of combustion flue gases, this process promises to gain swift acceptance by both utility and industrial coal consumers and enable further growth in the use of both low and high sulfur coal. Among the E-Beam FGT's unique features are included: simultaneous removal of SO_2 and NO/sub x/ at high removal efficiencies, dry process which involves no slurry recycling, no sludge disposal, and no gas-reheat; excellent turndown and load-following capabilities with a minimum of process control; and SO_2 and NO/sub x/ are converted into dry salable nitrogen fertilizer. The process is adaptable for future expected emission control requirements due to its simplicity of operation. Because of the flexibility of the process, tailoring to provide the required amount of treatment as imposed by present or future standards is a simple matter of varying either temperatures or dosages. As a retrofit, the Ebara E-Beam FGT can be easily configured to the site, since site requirements are far less than for conventional wet sulfur dioxide scrubbers. The purpose of this paper is to present a status update on the development of this process as well as to describe a demonstration unit using high sulfur coal currently in operation at the Indianapolis Power and Light Company in Indianapolis, Indiana.

42617 (CONF-850982—, pp 223-242) **Laboratory and field development of coolside SO_2 abatement technology.** Yoon, H.; Stouffer, M.R.; Rosenhoover, W.A.; Statnick, R.M. (Conoco Inc., Library, PA (USA)). 1985. NTIS, PC A99/MF A01. Order Number DE88007794/JAW.

From 2. annual Pittsburgh coal conference; Pittsburgh, PA, USA (16 Sep 1985).

The Conoco laboratory and one MW field development work has been successfully completed and has advanced the Coolside SO_2 abatement technology to a level for a utility demonstration. As developed, the technology can be applied alone using hydrated lime as the sorbent, or in combination with boiler limestone injection to achieve the best economics at a specific site. The observed SO_2 removals and sorbent utilizations in the field work were at the levels necessary for economical SO_2 controls. The SO_2 removals observed were ranged up to 80%. The Coolside technology is particularly suited to retrofit application because of its low capital requirement and low overall SO_2 control cost based on the observed results. The laboratory and field data indicate that humidification is the key element of the Coolside technology. It provides an active environment for SO_2 capture and effectively conditions the flue gas for efficient ESP operation. Conoco Coal Research Division is now conducting additional laboratory and engineering studies with particular emphasis on humidification. This additional work will provide an important data base for humidifier design and operation.

42618 (CONF-850982—, pp 244-256) **Pilot study of the sodium-based FGD system at the Jim Bridger Power Station.** Johnson, D.W.; Nischt, W.; Flynn, T.J. (Babcock & Wilcox Co., Barberton, OH (USA)). 1985. NTIS, PC A99/MF A01. Order Number DE88007794/JAW.

From 2. annual Pittsburgh coal conference; Pittsburgh, PA, USA (16 Sep 1985).

A pilot plant test program was conducted by Babcock & Wilcox (B & W) to demonstrate that its sodium-based FGD system would meet Pacific Power & Light's (PP & L) performance goals at its Jim Bridger Power Station. For PP & L, local abundance of waste soda liquor from the beneficiation of soda ash, absence of reagent preparation, and low operating costs make sodium-based SO_2 absorption more cost effective than a lime/limestone based process. During the pilot program, B & W's patented counterflow absorption tray was optimized for the Jim Bridger design conditions. The system's functional performance was characterized over a range of operating conditions such as load, SO_2 concentration, liquor spray flux, and pH. Correlations were developed for pressure drop and SO_2 removal efficiency as a function of operating conditions. The effects of scale formation on performance were also studied and characterized. The pilot plant program produced a commercial design that was low in both capital and operating costs.

42619 (CONF-850982—, pp 543-557) **Application of current utilization technologies to coal solid wastes of the future.** Burnet, G.; Murtha, M.J. (Ames Lab., IA (USA)). 1985. NTIS, PC A99/MF A01. Order Number DE88007794/JAW.

From 2. annual Pittsburgh coal conference; Pittsburgh, PA, USA (16 Sep 1985).

US utilities currently generate over 100 million tons of solid wastes per year. There is no single answer for the effective management of these wastes, but utilization to yield products that can be manufactured and marketed successfully is becoming increasing attractive as an alternative to disposal. Most established uses are construction related and include road base materials, structural fill, cement admixtures, light-weight aggregate and land reclamation. Other relatively high technology applications such as mineral recovery and the separation of magnetite and cenospheres are less well developed but offer significant opportunities. An important future consideration is the utilization of wastes resulting from new energy technologies and having different characteristics. Technologies included are fluidized bed boilers, flue gas dry scrubbers, and special multistage combustion burners. These developments will lead to replacement of pulverized coal fly ash with new ash forms which contain highly reactive materials such as alkaline oxides and sulfites. This paper briefly reviews current utilization technologies and examines their application to the solid wastes expected in the future.

42620 (CONF-850982—, pp 558-577) **Agricultural uses of atmospheric fluidized bed combustion residue (AFBCR) - a seven year study.** Bennett, O.L.; Hern, J.L.; Perry, H.D.; Reid, R.L.; Stout, W.L.; Edwards, J.H.; Smedley, K.O. (Appalachian Soil & Water Conservation Research Lab., Beckley, WV (USA)). 1985. NTIS, PC A99/MF A01. Order Number DE88007794/JAW.

From 2. annual Pittsburgh coal conference; Pittsburgh, PA, USA (16 Sep 1985).

Large amounts of solid waste are generated during the AFBC process. If this waste material can be used as a source of plant nutrients, agriculture will offer an environmentally safe means of recycling and disposal of the AFBC residue. The US Dept. of Agriculture, Agricultural Research Service, in cooperation with the US Dept. of Energy, has been conducting extensive laboratory, greenhouse, and field studies to evaluate the AFBC-residue material for agriculture during the past seven years. Studies include detailed chemical and physical evaluation of AFBCR; evaluation as a nutrient source for plant species in greenhouse, environmental growth chambers, and under field conditions; and carefully controlled metabolic studies with several animal species using crops grown with AFBCR as food sources. Chemical analyses of the AFBCR indicate

the presence of several elements essential for plant growth including significant amounts of Ca, Mg, and S, and smaller amounts of P, K, B, Cu, Fe, Zn, Mo, and Mn. The effectiveness of AFBCR as a soil liming material is normally about 50% of regular agricultural limestone. Heavy metals can be present, but concentrations are generally within acceptable ranges for application to soils when applied at normal rates as a liming material. All studies with plants indicate that AFBCR can serve as an effective source of Ca, Mg, and S, and as a liming material when applied at rates equivalent to $CaCO_3$. No detrimental effects were found when animals were fed diets produced on soil treated with AFBCR. Although all studies are not complete at present, all findings suggest that AFBCR can safely be used on agricultural soils as a liming material and source of plant nutrients.

42621 (CONF-850982—, pp 578-581) **Progress through cooperation: Brandon Wood Energy Business Park structural fly ash fill.** Parks, D.W. (Baltimore Gas and Electric Co., MD (USA)). 1985. NTIS, PC A99/MF A01. Order Number DE88007794/JAW.

From 2. annual Pittsburgh coal conference; Pittsburgh, PA, USA (16 Sep 1985).

This paper describes the steps taken by Baltimore Gas and Electric Company to convince community officials, regulatory bodies, and the general public of the safety and advantages of using fly ash for structural fill. Public relations programs included slide programs, tours of facilities, public meetings, and amending the legal definition of refuse. Engineering studies for the site are briefly mentioned.

42622 (CONF-850982—, pp 583-596) **Conversion of the 80's - slurry pumping: a vital economic decision.** Kalchthaler, R.F. Jr. (SRW Associates Inc., Pittsburgh, PA (USA)). 1985. NTIS, PC A99/MF A01. Order Number DE88007794/JAW.

From 2. annual Pittsburgh coal conference; Pittsburgh, PA, USA (16 Sep 1985).

An increasing portion of the total cost of mining and processing coal is associated with the disposal of coal refuse. In addition, current regulatory requirements and rising labor and energy (fuel) costs continue to increase the cost of refuse disposal. Of particular importance is the decision to install or continue to operate fine refuse dewatering systems or to convert to slurry pumping. With today's market conditions and regulatory atmosphere major capital investments and increasing operational costs associated with the transportation and placement of combined coal refuse demand a careful evaluation of the economics of converting to slurry pumping. The results of an industry survey which correlates with SRW Associates Inc.'s experience in the conversion process indicates a significant cost savings when converting to slurry pumping.

42623 (CONF-850982—, pp 597-602) **Coal combustion by-product utilization and handling.** Pattishall, J. (Pennsylvania Power and Light Co., Allentown (USA)). 1985. NTIS, PC A99/MF A01. Order Number DE88007794/JAW.

From 2. annual Pittsburgh coal conference; Pittsburgh, PA, USA (16 Sep 1985).

The increasing amounts of fly ash and bottom ash being generated each year make it imperative that alternatives to disposal be found. The regulations now in force are proving to be a considerable constraint to the increased use of these resources. This paper reviews fly ash and bottom ash utilization and handling methods now being used, and cites other markets that could be exploited if regulations were changed.

42624 (CONF-850982—, pp 742-754) **Air pollution control equipment considerations for coal water mixture combustion products.** Frazier, W.F.; Letarte, J.R. (Virginia Power, Richmond (USA)). 1985. NTIS, PC A99/MF A01. Order Number DE88007794/JAW.

From 2. annual Pittsburgh coal conference; Pittsburgh, PA, USA (16 Sep 1985).

Coal-water mixture fuels consist of approximately 70% clean, crushed coal mixed with 29% water and one percent proprietary additive which permits the CWM to remain stable during transportation and to be pumped like oil. A principal advantage of using CWM is that the fuel contains no oil. Assuming a production level of 1 million tons per year, CWM prices are anticipated to range from $2.80 to 3.50/MBtu. Because of the potential of coal-water mixtures (CWM) as a boiler fuel, a study was performed to examine the use of this fuel as an alternative to burning No. 6 oil at the Virginia Power Yorktown Unit 3 and Possum Point Unit 5 generating units. Both boilers are designed to burn crude or residual oil with no provisions for future conversion to coal. Yorktown Unit 3 is equipped to burn a limited quantity of natural gas. The gross electrical output of each unit at maximum continuous rating (MCR) is 875 megawatts. Details on the modifications required for converting both units to CWM and the results of an economic evaluation of these conversions have been previously reported. This paper presents results from the evaluation of the air pollution control equipment that might be required for converting Yorktown 3 and Possum Point 5 from oil to CWM. The air emissions from oil-fired generation are compared with the expected emissions from CWM combustion. The specific characteristics of CWM combustion products that would influence the design of particulate and SO_2 removal equipment are identified. Cost estimates are presented for retrofitting electrostatic precipitators to control particulate emissions and flue gas desulfurization equipment to control SO_2 emissions from CWM combustion.

42625 (EPA/600/9—80-039a) **Proceedings of the second symposium on the transfer and utilisation of particulate control technology. Volume 7. Control of emissions from coal fired boilers.** Venditti, F.P.; Armstrong, J.A.; Durham, M. (eds.). (Environmental Protection Agency, Washington, DC (USA). Office of Research and Development). Sep 1980. 639p. (PB—81-122202; CONF-790740—). NTIS.

From 2. symposium on transfer and utilization of particulate control technology; Denver, CO, USA (23 Jul 1979).

A total of 34 papers were presented at the symposium on the subject of controlling emissions from coal fired boilers. The volume is divided into 3 sections. Section A is concerned with electrostatic precipitators including their cost, performance, design, evaluation and modification. Papers on fly ash conditioning, SO_3 conditioning, the prediction of fly ash resistivity, analysis of thermal decomposition products of flue gas conditioning agents and biotoxicity of fly ash particulate are also included. Section B deals with fabric filters, and topics covered include their design, operation, performance testing and comparison with electrostatic precipitators, high velocity fabric filtration, passive electrostatic effects, baghouse design, construction and operation. Section C is concerned with scrubbers and includes papers on their design, testing and performance.

0109 Environmental Aspects

REFER ALSO TO CITATION(S) 42669, 43279, 43837, 43978

42626 (CRIEPI-T—86089) **Literature data base of atmospheric diffusion. Part 1.** Senshu, T. (Central Research Inst. of Electric Power Industry, Tokyo (Japan)). 1987. vp. (In Japanese). Central Institute of Electric Power Industry, Tokyo, Japan.

A set of literature data base concerning atmospheric diffusion problems which are related to the siting of power plants was developed. This data base contains the evaluation of the literature as well as the abstracts

42627 (EPA/600/9—80-004) **Proceedings: advances in particle sampling and measurement.** Smith, W.B. (ed.). (Environmental Protection Agency, Washington, DC (USA). Office of Research and Development). Jan 1980. 419p. (PB—80-187487; CONF-791018—). NTIS.

From Symposium on advances in particulate sampling and measurement; Daytona Beach, FL, USA (7 Oct 1979).

The proceedings consist of 20 reports of research on equipment and techniques for sampling and characterizing particulate emissions and other aerosols. The inhalable particle size range (up to 15 micrometers) is emphasized, and the basis for selecting this range as a standard is discussed. Novel or improved equipment includes: virtual impactors; impactors for sampling high dust loadings; an impactor/quartz-crystal microbalance combination used to sample stratospheric aerosols; a tapered-element oscillating micro-

balance for monitoring particulate emissions and aerosols; an automated piezoelectric microbalance for monitoring atmospheric aerosols; a hot-wire probe for measuring liquid droplets; sampling systems that are improvements on PEA Method 5 equipment for measuring mass emissions; and more efficient sampling probe inlets. New or improved techniques include: measurement of aerodynamic diameter by laser/doppler velocimetry of particles accelerated in a converging nozzle; automation of diffusion-battery/condensation nucleus counter systems; sampling inhalable particles in fugitive aerosols; particle-size spectrometry for characterizing inhalation toxicity; computer extrapolation of particle-size ranges; and the identification of impactor errors due to non-ideal behavior to particle deposition in sampling probe nozzles.

42628 **(EUR—11160-EN) Trace element emissions from fluidised bed combustion units.** (Commission of the European Communities, Luxembourg). 1987. 106p. British Coal, Stoke Orchard (United Kingdom). Coal Research Establishment.

The environmental impact of trace elements from fluidised bed fired industrial boilers burning UK coals has been assessed. Eleven potentially hazardous elements have been measured in the input and output streams of AFBC fired boilers, grate fired boilers and a 0.6 m experimental FBC rig. The survey covered twelve coals and four of British Coal's main production areas. For most elements, emissions depended on the gas cleaning plant rather than the method of firing. Arsenic was also affected by gas exit temperature and showed an 11-fold difference in emission rate over the range of temperatures encountered. Estimated daily average ground level concentrations are smaller than the values usually considered to represent whole population exposure limits by several orders of magnitude. Neither the addition of limestone to retain SO_2 nor staged combustion to reduce formation of NOx is likely to increase emissions of trace elements enough to cause concern about health hazards. 51 refs., 20 figs., 34 tabs.

0110 Reserves And Exploration

REFER ALSO TO CITATION(S) 42596, 42633

42629 **(ACIRL-PR—87-7) Geotechnical applications and interpretation of downhole geophysical logs.** (Australian Coal Industry Research Labs. Ltd., North Ryde). Nov 1987. 65p. Australian Coal Industry Research Laboratories Ltd., North Ryde, NSW, Australia.

The use of downhole geophysical logs for geotechnical purposes is discussed in this report, and the results of an experimental program correlating uniaxial compressive strength, indirect tensile strength, elastic modulus and porosity of drillcore specimens with sonic and neutron log response are detailed. Other geophysical logs were used for supplementary information, but were not correlated with geomechanical parameters. The emphasis of the discussion is on empirical interpretation and application of currently available techniques used in coal exploration, rather than on the theoretical basis for the geophysical response or the instrumentation employed. The main motivation for the investigation was the need to provide geomechanical input data for numerical and physical modelling of underground excavations. Approximately 1000 uniaxial compressive strength (UCS) results from 40 drillholes, located at 18 colliery sites, were used in the correlation, along with 400 elastic moduli and 100 tensile strength results. A wide variety of sedimentary rocks with strengths up to 200 MPa, but mainly in the range 40-100 MPa, were included. Special attention was given to estimating the strength of weak rock (UCS less than 60 MPa) and of coal. Empirical relationships between UCS, indirect tensile strength, static elastic modulus, porosity and sonic and neutron log response are presented. The principal conclusions are that sonic log response correlates well with rock strength and modulus; that neutron logs are inferior to sonic for strength estimation, but useful for lithological interpretation; that porosities estimated from sonic and neutron logs may be very much greater than those measured in core specimens, due to the influence of clay-filled voids; and that laboratory measurements of sonic velocity are generally lower than in-situ values, due to the effects of stress relief on core specimens. 24 refs., 20 figs, 8 tabs.

42630 **(BMR—219) Permian and late Carboniferous palynostratigraphy of the Galilee Basin, Queensland.** Norvick, M. (Bureau of Mineral Resources, Geology and Geophysics, Canberra (Australia)). 1981. 156p. Bureau of Mineral Resources, Geology and Geophysics, Canberra (Australia).

BMR microform MF114.

Palynological information from the Upper Carboniferous and Permian of 42 petroleum exploration well sections and two outcrop sections in the Galilee Basin, central Queensland, is compiled and re-evaluated. These data are used firstly to test and refine the eastern Australian Late Palaeozoic spore-pollen stage zonation of Evans, and secondly to show the broad geological evolution of the basin. The stratigraphic ranges of selected spore-pollen species and species groups are used to define a sequence of nine Late Carboniferous and Permian palynologic intervals, with wide application in eastern Australia. The relationship between these stages and existing zonations is discussed. In the Galilee Basin, Late Carboniferous stage 1 is represented by a thick, glaciogenic, coarse clastic sequence. Early Permian stage 2 comprises coarse clastics, passing up into a possibly glaciogenic fine clastic unit. Coal measure sedimentation began in Early Permian stage 3, possibly indicating warmer climatic conditions. A basinwide hiatus removed all of stage 4 and the lower part of stage 5. Upper stage 5, of late Early to Late Permian age, saw the widespread development of coal measures. Uppermost Permian rocks have not yet been recorded. The Galilee Basin was outside the influence of the sea, except during upper stage 5, when short-lived marine incursions extended into its southeastern margin.

42631 (CONF-850982—, pp 286-305) **Engineering approach to estimating economically recoverable coal reserves.** Gunnett, J.W. (Skelly and Loy, Harrisburg, PA (USA)). 1985. NTIS, PC A99/MF A01. Order Number DE88007794/JAW.

From 2. annual Pittsburgh coal conference; Pittsburgh, PA, USA (16 Sep 1985).

The advent of acid rain legislation will most likely produce a major increase in low sulfur coal consumption/production which will draw from today's economically recoverable reserve base. Considering the uncertainty of reserve estimates, the Electric Power Research Institute (EPRI) commissioned a study to provide an appraisal of the availability of low sulfur supplies. Project efforts were focused on four study areas including: eastern Kentucky; West Virginia; Virginia; and Pennsylvania. Each of these states has been reported to contain major low sulfur Appalachian coal reserves. The investigative approach entailed: (1) assessment of published reserve estimates at both the state and federal levels. (2) Development of a procedure for defining technically and economically recoverable reserves at specified f.o.b. mine prices. (3) Definition of current and future f.o.b. prices for low sulfur coal in the study area. (4) Perform reserve area analyses to facilitate comparison of the recommended engineering/economic reserve calculation procedure with the methodology utilized to compute reserves documented in a selected publication. (5) Establish current excess production capacity in the study area. (6) Project the future demand and resultant consumption of low sulfur metallurgical reserves. (7) Analyze the implications of study findings with respect to estimation of available low sulfur reserves. This paper focuses on the reserve estimation procedure developed by Skelly and Loy as a portion of EPRI's total project.

42632 **(NERDDP-EG—87-640) Improvements to borehole logging techniques and instrumentation for coal.** Borsaru, M. . (National Energy Research, Development and Demonstration Council, Canberra (Australia)). Oct 1986. 31p. Dept. of Resources and Energy, GPO Box 858, Canberra, ACT 2601, Australia.

The neutron capture and gamma-gamma techniques for coal ash measurement in water-filled boreholes, developed in the previous NERDDC project No. 81/1364, were extended in the present project to dry and larger-diameter water-filled boreholes respectively. The rms deviation for both techniques is less than 2% ash. A collaborative licensing agreement was signed between CSIRO and Geosource Inc. so that Geosource will manufacture and market the SIROLOG logging equipment.

0120 Mining

REFER ALSO TO CITATION(S) 42631

42633 (CANMET—87-3E) Coal mining in Canada: 1986. Romaniuk, A.S.; Naidu, H.G. (Canada Centre for Mineral and Energy Technology, Ottawa, Ontario). Sep 1987. 50p. Canada Centre for Mineral and Energy Technology, Ottawa, Ontario.

Information is provided on two major areas of the Canadian coal industry - coal reserves and coal mining operations. The coal reserve quantities updates information released in a report of the same title from 1983. Reserves are presented by province, coalfield, rank, likely mining method and by heating value. Canada's coal mining operations are discussed in terms of mine location, operating officials, number of employees, mining and coal preparation methods, major equipment and production statistics. 17 refs., 5 figs., 12 tabs.

42634 (CRL—87-76(TR)) An analytical method for determining trace levels of sulfur hexafluoride, bromotrifluoromethane and dichlorofluoromethane in mine air samples. Kennedy, D.J. (Canada Centre for Mineral and Energy Technology, Sydney, Nova Scotia. Cape Breton Coal Research Lab.). Jul 1987. 13p. CANMET, 555 Booth Street, Ottawa, Ontario, Canada.

Sulfur hexafluoride has been used quite extensively as a tracer gas for analyzing mine ventilation systems. In this paper the advantages of two or more different tracer gases -- sulfur hexafluoride, bromotrifluoromethane and dichlorodifluoromethane, are examined. The analytical method and equipment employed to measure trace levels of these gases are described. 3 refs., 4 figs.

42635 (ERP/CRL—87-45(TR)) Improvements in pack design at Lingan Colliery. (Canada Centre for Mineral and Energy Technology, Sydney, Nova Scotia. Cape Breton Coal Research Lab.). Apr 1987. 33p. CANMET, Sydney, N.S (Canada). Cape Breton Coal Research Laboratory.

Effects of changes in packing methods undertaken at Lingan Colliery have been monitored. In an effort to prevent gob leakage and allow safe and efficient production a monolithic pumped packing trial was implemented at the maingate. In the tailgates, a new wooden pack design resulted in increased pack resistance, which consequently improved strata control. The successful implementation of these changes at Lingan Colliery have resulted in beneficial effects to colliery operations. 3 refs., 14 figs., 11 tabs.

42636 (ERP/CRL—87-61(TR)) Haulroad design at Highvale mine. Whipple, R.; Kolada, R.J. (Canada Centre for Mineral and Energy Technology, Devon, Alberta. Coal Research Lab.). Jun 1987. 17p. CANMET, Devon, Alberta (Canada). Coal Research Laboratories.

This project was undertaken as part of a study to investigate criteria by which mine haulage roads are designed and tested in order to determine how road construction affects rolling resistance. Field testing of soil samples, haul road design and construction, and rolling resistance testing of a rear-end dump truck were the main areas of study. 3 refs., 1 tab.

42637 (ERP/CRL—87-71(TR)) Blast casting at Minto coal mine, New Brunswick. Naidu, H.G. (Canada Centre for Mineral and Energy Technology, Ottawa, Ontario). Jul 1987. 19p. CANMET, Ottawa, Ontario.

In an effort to reduce production costs the Minto coal mine of New Brunswick examined the potential of blast casting. Preliminary investigation began with the use of a modular computer program SABREX (Scientific Approach to Breaking Rock with Explosives). A test blast was then conducted using high-speed cameras to record the event. The field results matched very closely with those predicted in the model. Results of these tests were considered encouraging and a larger scale field test is being considered. 2 refs., 8 figs., 1 tab.

42638 (ERP/CRL—87-84(TR)) Cone penetrometer testing at Gregg River mine. Whipple, R.; Kolada, R.J. (Canada Centre for Mineral and Energy Technology, Devon, Alberta. Coal Research Lab.). Aug 1987. 10p. CANMET, Devon, Alberta (Canada). Coal Research Laboratories.

The cone penetrometer test is a method for measuring resistance of soils to static or dynamic penetration of cones. Results of cone penetrometer tests performed at the Gregg River mine are presented. Tests were performed in an active mining area. 1) on the pit floor, 2) after a layer of coal had been scraped away and, 3) in a tire track left by a rolling resistance vehicle. Results were considered successful and provided sufficient data for limited statistical analysis. 3 refs.

42639 (EUR—11093-DE) Investigating the application of composite rock-bolt support systems in the coal mining industry. Reuther, E.-U.; Hermuelheim, W. (Commission of the European Communities, Luxembourg). 1987. 177p. (In German). European Community Information Service, 2100 M St., NW, Suite 707, Washington, DC 20037.

The use of rock bolts in conjunction with an appropriate lagging system offers a solution to the mechanisation of support work in mine roadways and is being promoted within the EEC countries. Types of rock bolt commercially available are presented along with theories concerning their interaction with the strata and previous experience gained in this field, with the aim of preparing recommendations for a composite rock bolted support system for parallel headings serving longwall faces. Measures which will increase safety in rock bolted roadways are proposed. Strata formerly considered unsuitable for bolting may now be controllable using long-reach bolts and cable linked lagging, and a cost estimate is undertaken for this system. Underground trials are recommended. 104 refs., 91 figs., 7 tabs.

42640 (IOM-TM—86-11) Ergonomic design handbook for continuous-miners. Collier, S.G.; Chan, W.L.; Mason, S.; Pethick, A.J. (Institute of Occupational Medicine, Edinburgh (UK)). Dec 1986. 131p. Institute of Occupational Medicine, Edinburgh, United Kingdom.

Underground investigations of development machines by the Institute of Occupational Medicine have revealed a number of ergonomic problems relating to machine operation as well as others affecting the health and safety of the workforce. This handbook is intended as an aid for the designers of continuous miners to help eliminate or reduce these ergonomic problems to improve health, safety and machine performance. Topics covered include: preferred posture; overhead clearances; lateral safety clearance; seating design; lines of sight; operator access; control design, location and layout; display design, location and layout; labelling; machine-mounted lighting; thermal environment; auditory environment; machine vibration; maintenance; ancillary tasks.

42641 (MandET/MRL—86-41(TR)) List of certified equipment and materials for use in underground mines. Bossert, J.A.; Lobay, G.; Ralph, M.S. (Canada Centre for Mineral and Energy Technology, Ottawa, Ontario). Mar 1986. 83p. CANMET, Ottawa, Ontario.

This publication presents a list of equipment and materials certified for use in underground mining operations in Canada. The information covers many safety and health aspects of mining and includes: flameproof electrical equipment, flameproof diesel-powered equipment, fire-resistant conveyor belting, fire-resistant and static-free ventilating ducts, and combustible gas detection systems.

0130 Transport And Handling

REFER ALSO TO CITATION(S) 42636

42642 (CANMET-SP—86-16E) Selected theoretical and practical aspects of studies made in conjunction with the joint Canada/FRG research project on coarse-slurry, short distance pipelining. (Canada Centre for Mineral and Energy Technology, Ottawa, Ontario). Dec 1986. 143p. Canada Centre for Mineral and Energy Technology, Ottawa, Ontario.

This project on coal slurry pipelines was conducted under an agreement between the governments of Canada and the Federal Republic of Germany. The goals of the program were to determine the hydraulic performance of run-of mine coals, cleaned coals and washery wastes when transported by pipeline for comparatively short distances. In this report results of earlier coal slurry pipeline studies and mathematical models, as proposed by K.C. Wilson and C.A. Shook, are examined. The model prepared by K.C. Wilson for coarse-slurry pipelining is central to the work reported on. Results of short studies of some theoretical and practical topics encountered in the literature relating to the Wilson model are included. 64 refs., 14 figs., 18 tabs.

0140 Combustion

REFER ALSO TO CITATION(S) 42579, 42601, 42610, 42628

42643 (CONF-850982—, pp 3-11) **Utility development and demonstration of AFBC technology.** Mayfield, M.J.; Manaker, A.M.; Lumpkin, R.L. Jr. (Tennessee Valley Authority, Chattanooga (USA)). 1985. NTIS, PC A99/MF A01. Order Number DE88007794/JAW.

From 2. annual Pittsburgh coal conference; Pittsburgh, PA, USA (16 Sep 1985).

Fluidized bed combustion (FBC) is an advanced coal burning process which provides a method of burning coal economically and in an environmentally acceptable manner. This technology offers a near-term alternative to conventional pulverized coal (PC) steam plants which require a complex environmental control technology in order to meet emission standards. In principal, the Atmospheric Fluidized Bed Combustion (AFBC) process is very simple. This paper discusses the TWA's involvement in AFBC development, describes both the 20-MW pilot plant and the 160-MW demonstration plant, and gives details on the status of AFBC technology.

42644 (CONF-850982—, pp 317-325) **Assessment of state initiatives to promote the financing of coal conversion and cogeneration projects in Pennsylvania.** Bickley, D.C. (Governor's Energy Council, Harrisburg, PA (USA)). 1985. NTIS, PC A99/MF A01. Order Number DE88007794/JAW.

From 2. annual Pittsburgh coal conference; Pittsburgh, PA, USA (16 Sep 1985).

Over the past several years the Governor's Energy Council has been involved in numerous energy related initiatives involving energy conservation, energy efficiency, cogeneration, renewables, and coal conversion and use. And invariably each initiative has in some fashion addressed, or confronted, the topic of how to finance the various meritorious projects identified or analyzed. This paper is a description of several GEC initiatives to address this financing issue as part of the GEC's attempt to end stories with successfully implemented projects throughout the Commonwealth of Pennsylvania. The paper is divided into three GEC initiatives. First, for the past three years the GEC has conducted a program to cofund feasibility studies for coal conversion and/or cogeneration. This program involved the direct participation of industries and institutions with state government in the economic and technical analysis of the energy projects. Second, the GEC in conjunction with other state agencies has embarked on a third party financing initiative for state buildings. This initiative was undertaken to enable capital constrained state agencies to embark on energy conservation, fuel conversion, and cogeneration projects. And third, fulfilling a need to give energy managers and planners a sophisticated yet simplistic tool for analyzing the financial alternatives for energy projects, the GEC developed a software program called ENVEST.

42645 (CONF-850982—, pp 356-364) **Effective sulfur capture by Battelle treated coal under simulated combustion turbine conditions.** Reuther, J.J.; Conkle, H.N.; Webb, P.R.; Feldmann, H.F. (Battelle Columbus Labs., OH (USA)). 1985. NTIS, PC A99/MF A01. Order Number DE88007794/JAW. Contract AC21-84MC21289.

From 2. annual Pittsburgh coal conference; Pittsburgh, PA, USA (16 Sep 1985).

This paper presents the results of an on-going program, sponsored by the US Dept. of Energy, designed to determine (1) the technical feasibility of reliably and cleanly firing pulverized coal in advanced combustion turbines, and (2) the temperature and pressure dependencies of the in situ sulfur capture efficiency of a selection of coals under simulated combustion turbine conditions. The selection of pulverized fuels studied consisted of (1) raw high-sulfur Illinois No. 6 coal, (2) the raw coal converted into Battelle Treated Coal (BTC) via a proprietary calcium impregnation process and (3) the raw coal physically mixed with lime. The simulated combustion turbine conditions consisted of super-atmospheric pressure, ultra-high excess air, moderate average firing temperature, and high carbon conversion. The analytical and experimental analyses conducted for the program indicate that BTC is favored as a fuel for advanced, coal-capable combustion turbines. Not only do the BTC fuel and flame possess the properties necessary to make coal firing technologically feasible in turbines, they also allow for such combustion to be conducted in an environmentally acceptable manner without the need for troublesome flue gas desulfurization or more expensive chemical coal cleaning.

42646 (CONF-850982—, pp 534-539) **Utilization of medium-sulfur slurry fuels by a fluid-bed calcium/sulfur contactor.** Green, L. Jr. (Energy Conversion Alternatives, Ltd., Washington, DC (USA)). 1985. NTIS, PC A99/MF A01. Order Number DE88007794/JAW.

From 2. annual Pittsburgh coal conference; Pittsburgh, PA, USA (16 Sep 1985).

Coal-water fuel technology provides the basis of a method for utilizing high-sulfur coals from northern Appalachia and the eastern Midwest in compliance with stringent limitations on sulfur dioxide emissions. The high fraction of pyritic sulfur in such coals is substantially removed in the deep de-ashing operation required for CWF preparation. The medium-sulfur CWF thereby produced is then fired in conventional CWF atomizer/burners operating under gas-assisted, substoichiometric combustion conditions, with simultaneous injection of fine limestone or other sulfur-sorbent particles. These pre-burners discharge their products tangentially into the bottom of a deep, air-fluidized bed of ceramic heat-transfer particles in which combustion is completed. Intimate contact between the sulfur dioxide combustion product and the limestone particles is promoted by the intense mixing action within the combustion-stirred bed, thus permitting operation at a low Ca/S ratio approaching unity. Control of the bed temperature below 1650 F assures sulfur retention and prevents formation of nitrogen oxides. Separation of the limestone particles and capture of the still finer ash and calcium sulfate product particles are accomplished in a hot cyclone and a fabric-filter baghouse, respectively.

42647 (CONF-850982—, pp 605-624) **Transport model for devolatilization or large nonplastic coal particles.** Devanathan, N.; Saxena, S.C. (Univ. of Illinois, Chicago (USA)). 1985. NTIS, PC A99/MF A01. Order Number DE88007794/JAW.

From 2. annual Pittsburgh coal conference; Pittsburgh, PA, USA (16 Sep 1985).

A model has been proposed for the devolatilization of large coal particles taking into consideration the heat and mass transport phenomena along with the kinetics of the pyrolysis reaction. The conservation equations have been solved numerically to obtain the concentration and temperature profiles. The effect of various parameters on reactant conversion and volatile evolution have been considered. An approximate analytical solution has been provided for small values of Thiele modulus, and a shrinking core model has been developed for the heat-transfer controlled situation. Computations reveal that neglecting mass-transfer resistance underpredicts the time for devolatilization, and the magnitude depends upon the value of the Thiele modulus. Further, parametric investigations show that the Thiele modulus, Lewis number and heat-transfer Biot number are crucial parameters in determining the time for devolatilization. While the bed temperature has a moderate influence on the time for devolatilization, the mass transfer Biot number has little or no influence on the devolatilization time.

42648 (CONF-850982—, pp 626-637) **Basic studies of coal plasticity kinetics.** Fong, W.S.; Peters, W.A.; Howard, J.B. (Massachusetts Institute of Technology, Cambridge (USA)). 1985. NTIS, PC A99/MF A01. Order Number DE88007794/JAW. Contract AC21-82MC19207.

From 2. annual Pittsburgh coal conference; Pittsburgh, PA, USA (16 Sep 1985).

A laboratory scale instrument for quantitative characterization of the plasticity of softening coals under rapid-heating, high temperature conditions has been demonstrated. Data from this instrument and from measurements of intra-particle inventories of extractables via a rapid quench and extraction technique, have provided quantitative understanding of the underlying chemical kinetic and physical transport phenomena contributing to coal plasticity. Potential applications of plasticity kinetics to practical problems in coal utilization are illustrated by a model of particle agglomeration in a turbulent flow.

42649 (CONF-850982—, pp 638-647) **Effect of energy feedback mechanisms on the oxidation rate of pulverized coal.** Kruger, C.H.; Choi, S.; Haussmann, G. (Stanford Univ., CA (USA)). 1985. NTIS, PC A99/MF A01. Order Number DE88007794/JAW.

From 2. annual Pittsburgh coal conference; Pittsburgh, PA, USA (16 Sep 1985).

A series of pulverized coal combustion experiments has been performed in the Stanford flow-tube reactor in which the oxygen concentration, particle size, and the gas temperature were independently varied. The rapid mass release observed during the early stages of coal combustion, along with the observation of a luminous volatile cloud surrounding individual coal particles, indicates the potential importance of energy feedback mechanisms during this phase of pulverized coal combustion. Future efforts at Stanford will be directed towards the use of computer modeling work to identify conditions under which energy feedback mechanisms are expected to be significant. This modeling work will be used along with experimental results to determine the combustion conditions to be used in the next series of reactor tests.

42650 (CONF-850982—, pp 648-657) **Experimentally determined reactivities of coal chars.** Mitchell, R.E. (Sandia National Lab., Livermore, CA (USA)). 1985. NTIS, PC A99/MF A01. Order Number DE88007794/JAW.

From 2. annual Pittsburgh coal conference; Pittsburgh, PA, USA (16 Sep 1985).

Simultaneous measurements of the size, temperature and velocity of single pulverized coal particles have been used to determine the overall burning rates of the chars of coals flowing in hot, oxidizing gaseous environments. The single film model of a burning carbon particle is employed with CO as the sole heterogeneous reaction product. Expressions for the chemical reaction rate coefficients which include the combined effects or pore diffusion and the intrinsic chemical reactivity of the particle material are derived for the coals employed.

42651 (CONF-850982—, pp 658-665) **Ignition of captive coal water droplets: determination of reaction penetration depths.** Zghoul, A.M.; Essenhigh, R.H. (Ohio State Univ., Columbus (USA)). 1985. NTIS, PC A99/MF A01. Order Number DE88007794/JAW.

From 2. annual Pittsburgh coal conference; Pittsburgh, PA, USA (16 Sep 1985).

Ignition temperatures (T/sub i/) of coal-water slurry (CWS) droplets, in the size range 1 to 3 mm, were measured by heating them when held captive on a 0.5 mm thermocouple between two flat-spiral coils of resistance wire heated to 1000C. In previous experiments this system was used to measure times for the CWS drops to: heat-to-evaporation; evaporate; heat-to-ignition; and burnout; with generally good agreement between predictions and experiment, thus substantiating the supporting theoretical analysis and the calibration of the thermal field. The TC response curves showed characteristic increases in slope at ignition. The majority of the ignition temperatures were in the range 200 to 400C, which is generally below pyrolysis temperature for a bituminous coal. Prediction of the ignition temperature was therefore based on the assumption of heterogeneous ignition using Thermal Explosion Theory analysis. The kinetic equation used in the TET analysis incorporated a parameter, epsilon, that represented the ratio of internal to external reaction. The ignition temperatures were predicted to be almost independent of diameter at constant epsilon. The experimental results, however, showed that T/sub i/ declined almost linearly with diameter. The conclusion, from comparison with the predicted ignition temperatures, was that use of the internal surface or penetration depth of the reaction had to be increasing as diameter increased, thus offsetting the lower reactivity at lower temperatures for the larger diameter particles.

42652 (CONF-850982—, pp 689-694) **Studies of ash deposit formation using a laboratory furnace.** Benson, S.A.; Tangsathitkulchai, M.; Austin, L.G. (Pennsylvania State Univ., University Park (USA)). 1985. NTIS, PC A99/MF A01. Order Number DE88007794/JAW. Contract FG22-84PC70770.

From 2. annual Pittsburgh coal conference; Pittsburgh, PA, USA (16 Sep 1985).

A vertical externally-heated tube furnace has been used to study ash deposits. A thin ray of pulverized coal is combusted in the tube to simulate the temperature-time history of a pulverized coal flame. The combustion products at 1300 C are passed through a nozzle to accelerate them to about 3 m/sec and impacted on a flat oxidized boiler steel substrate held at 500 C. The deposits that form consist of four regions: (1) a layer of ash particles strongly adhered to the oxide layer of the substrate; (2) a weak layer of loosely sintered spheres; (3) a higher layer showing strongly sintered spheres; (4) a strongly sintered or partially melted top. The deposits are studied to determine chemical composition and crystalline phases. Scanning electron microscopy and microprobe analysis are used to examine cross-sections of the deposit for morphological and compositional variations. Upper Freeport bituminous coal and a Beulah-Zap lignite are compared in this study.

42653 (CONF-850982—, pp 695-711) **Impact of segregated mineral matter on fireside deposits.** Bryers, R.W. (Foster Wheeler Development Corp., Livingston, NJ (USA)). 1985. NTIS, PC A99/MF A01. Order Number DE88007794/JAW. Contract AC22-81PC40268.

From 2. annual Pittsburgh coal conference; Pittsburgh, PA, USA (16 Sep 1985).

The mineral content of any given rank of coal is a key factor in sizing and designing a steam generator or reactor. The mineral content becomes even more important as the premium solid fuels are consumed, leaving coal with higher mineral concentrations and lower quality ash. The problem of dealing with lower quality ash in coals is compounded by the increase in size of steam generators and refinements imposed by economic constraints. Empirical indices, based on coal elemental ash composition, and ASTM ash fusion temperatures or viscosities are presently used to rank coals according to the fireside behavior of the mineral matter. The elements found in the coal ash frequently occur in a variety of mineral forms, each with a decidedly different thermal history during combustion and each affected in a different way by its association with other mineral species or carbonaceous matter. A true understanding of the behavior of impurities in coal during combustion requires an examination of the occurrence of the minerals within the coal. This paper discusses mineral matter in coal and its transformation during coalification. Using photomicrographs the thermal behavior of illite and pyrite is described. Slagging and fouling of convective surfaces is also discussed.

42654 (CONF-850982—, pp 712-719) **Deposition tendencies for selected coal combusted at atmospheric pressure.** Anderson, R.J.; Romanowski, C.J. (Morgantown Energy Technology Center, WV (USA)). 1985. NTIS, PC A99/MF A01. Order Number DE88007794/JAW.

From 2. annual Pittsburgh coal conference; Pittsburgh, PA, USA (16 Sep 1985).

Laboratory experiments are being conducted to address the problem of deposit formation in heat engines. Such deposits are formed by the accumulation of inorganic fuel contaminants on engine components and can result in increased engine maintenance levels and reduced engine efficiency. The basic mechanisms of deposit formation in heat engines are being studied at atmospheric pressure in a laboratory entrained reactor (LETR). A versatile,

pressurized facility is currently under construction. This combustion/deposition entrained reactor (CDER) will be available for deposition testing in FY 86 for pressures up to 10 atmospheres. Specifically, the laboratory deposition tests examine the adherence fraction of residual coal ash particles from a combustion stream impinging onto a target of controlled surface temperature. This information allows the determination of the sticking coefficient for residual coal ash particles. The sticking coefficient is defined as the weight fraction of particles which adhere to a surface following impaction with the surface. This parameter is a necessary input to the ultimate prediction of deposition rate for a specific heat engine/fuel application. In addition to determining particle adherence, the composition of the deposits is being analyzed to identify the components that contribute most to the initial deposition process. By identifying these bad actors, a prediction of the potential deposition behavior of a coal can be made and appropriate action taken to minimize deposition; e.g., cleaning the coal or operating the heat engine at nominal conditions which inhibit deposit formation.

42655 (CONF-850982—, pp 723-739) **Development and test data of a multiple staged-mixing burner using fuel staging.** Leikert, K.; Rennert, K.D.; Schreier, W. (L & C Steinmueller GmbH, Gummersbach (Germany, F.R.)). 1985. NTIS, PC A99/MF A01. Order Number DE88007794/JAW.

From 2. annual Pittsburgh coal conference; Pittsburgh, PA, USA (16 Sep 1985).

The possibilities of reducing NOx emissions by fuel staging were investigated in a 15 MW test plant. Due to the variable geometry of the test burner it was possible to conduct parameter studies for the purpose of optimizing the combustion process and burner design. The salient parameters were: residence time under reducing conditions; stoichiometry in the reducing zone; and primary/secondary fuel distribution. Four coal types of different composition and reactivity were fired, namely a medium-volatile, and two high-volatile bituminous, and a brown coal. The optimum burner design is not identical for all coal types. The most favorable burner arrangement must therefore be determined by tailoring the main parameters to the type of coal fired. The high-volatile coals yielded the best results with respect to NOx and burn out. NOx figures less than 200 ppm related to 0% O_2 were measured for a high-volatile bituminous coal. The best results for brown coal ranged below 140 ppm. The best results for the medium-volatile coal were in the order of 270 ppm.

42656 (CONF-850982—, pp 756-765) **Development of high intensity precombustor for industrial boiler fuel conversion.** Shiraha, M.; Ehara, L.; Matsuura, Y. (Kawasaki Heavy Industries, Ltd., Akashi (Japan)). 1985. NTIS, PC A99/MF A01. Order Number DE88007794/JAW.

From 2. annual Pittsburgh coal conference; Pittsburgh, PA, USA (16 Sep 1985).

This paper describes two types of combustor development activities for retrofit of oil-fired boilers. The one is the derade coke combustor (DCC) characterized by small quantities of supplemental oil, less than 5%. The other is the coal partial combustor (CPC) characterized by slag removal through the high intensity slagging combustion. The former was developed and applied to the existing boiler successfully. The latter is now under development. Both advanced combustors have the compact precombustor attached directly to the burner port of the existing boiler and provide clean, fuel rich combustor products. For the development of DCC, a series of combustion tests were carried out using the bench scale combustor (2.5 MWt). The improved combustor was applied to the existing industrial 57 t/h boiler. Operation results since last autumn showed that (1) 5% supplemental oil is enough for stable operation, (2) combustion efficiency of DCC reaches 97%, (3) refractory lifetime is estimated to be in excess of one year. The experience of development activities of DCC was applied to the development of coal partial combustor. It was designed to be of the slagging type to prevent the ash carryover into the boiler furnace. Test results of laboratory scale (0.5 MWt) showed that (1) slag removal ranges are 70-90%, (2) NOx emission can be reduced to 120-170 ppm by fuel rich operation, (3) combustion efficiency exceeds 99.5%.

42657 (CONF-850982—, pp 769-775) **Wet oxidation applications to coal utilization.** Engleman, V.S. (Science Applications International Corp., San Diego, CA (USA)). 1985. NTIS, PC A99/MF A01. Order Number DE88007794/JAW.

From 2. annual Pittsburgh coal conference; Pittsburgh, PA, USA (16 Sep 1985).

Wet oxidation is a process in which organic material is oxidized by air, or other oxygen-containing gas, in the presence of liquid water. The reaction occurs at moderate temperatures (250-370 C for subcritical wet oxidation) and elevated pressures (1000-3500 psi). The amount of heat released by wet oxidation is the same as the heat released by conventional combustion of the same material. The heat is used to vaporize water, by direct heat exchange, at a temperature controlled by the pressure of the reactor. It has been found that NO/sub x/ and SO/sub x/ emissions from the reactor are very low and that the particulates are retained in the liquid slurry. The energy from the reaction can be recovered by direct use of the steam, by heat exchange to produce clean steam, or through an expander to produce mechanical or electrical energy. A current project, sponsored by the Dept. of Energy, is underway to investigate the application of wet oxidation to coal combustion for the production of industrial steam. The purpose of this paper is to review past work on wet oxidation for coal utilization and to examine the possibilities of future application. Past uses of wet oxidation include the production of soluble acids, coal desulfurization, gasification by supercritical wet air oxidation, and waste treatment.

42658 (CONF-850982—, pp 776-784) **Development of retrofit external slagging coal combustor system.** Mattsson, A.C.J.; Stankevics, J.O.A. (Avco Everett Research Lab., Inc., MA (USA)). 1985. NTIS, PC A99/MF A01. Order Number DE88007794/JAW. Contract AC22-84PC60417.

From 2. annual Pittsburgh coal conference; Pittsburgh, PA, USA (16 Sep 1985).

The retrofit coal combustor system now under development by Avco Everett Research Laboratory, Inc. (AERL) is based on replacement of each oil-gun burner assembly by a compact external coal combustor. This unit operates as a high thermal intensity, slag rejecting combustor, under fuel rich stoichiometry. The combustion products exhaust into the boiler where secondary air addition completes fuel oxidation while controlling thermal NO/sub x/ production. This retrofit design approach is based on previous development work and tests in the areas of coal combustion, slag management and combined cycle coal combustion MHD technology. The Avco vortex type coal combustor design concept is of single stage configuration which enables the achievement of high overall thermal efficiency and rejection of ash-slag particles. It is important to reject a major portion of the coal ash in the external combustor in order to prevent serious boiler fouling problems and consequent derating of the boiler. The small physical scale of the combustor, for practical retrofit sizing, is obtained by use of a fuel-oxidizer jet-driven combustion flow field with very high recirculation and excellent high intensity mixing. This paper describes general background data base, reactivation and modification of the existing MHD combustor system at the AvcoHaverhill Test Facility, and preliminary combustion tests with the modified MHD combustor using pulverized coal. A design of the 25 x 10^6 (BTUHr) Development Test Combustor has been completed and analytical combustor flow modeling with combustor model flow tests are in progress to optimize a preliminary design scale-up of the 50 x 10^6 (BTUHr) combustor for Phase II tests.

42659 (CONF-850982—, pp 785-793) **Development of a coal burning vortex containment combustor.** La Fond, J.F.; Payne, R. (Energy and Environmental Research Corp., Irvine, CA (USA)). 1985. NTIS, PC A99/MF A01. Order Number DE88007794/JAW. Contract AC22-83PC60420.

From 2. annual Pittsburgh coal conference; Pittsburgh, PA, USA (16 Sep 1985).

For several years industry and government research funds have been directed towards making coal an economically viable replacement for oil- and natural gas-firing in boilers, furnaces and heaters. Recently, the harmful effects of acid rain have become evident, motivating more stringent pollution control requirements. This has led to renewed interest in coal-fired precombustors as a

means of burning coal cleanly. The precombustor concept combines the efficient combustor of coal with internal pollution control techniques (combustion staging and reburning, and sorbent injection) to allow coal to be used in place of cleaner burning fossil fuels. This paper presents an overview of the progress made on one such coal-fired precombustor development program.

42660 (CONF-850982—, pp 794-803) **Development of a pulse coal combustor fired with CWM.** Mansour, M.N. (Management and Technical Consultants, Inc., Columbia, MD (USA)). 1985. NTIS, PC A99/MF A01. Order Number DE88007794/JAW. Contract AC22-83PC60419.

From 2. annual Pittsburgh coal conference; Pittsburgh, PA, USA (16 Sep 1985).

This paper presents the results of an R & D program being conducted for the Dept. of Energy (DOE), Pittsburgh Energy Technology Center, aimed at developing a new burner technology for coal-water mixture (CWM) fuels to enable use of these new fuels in utility and industrial boilers and process heaters currently firing oil and gas. This new burner technology is based on the principle of pulse combustion. The application of pulse combustion to CWM fuels is expected to alleviate many of the physical and environmental constraints associated with the direct use of these fuels in equipment designed for oil and gas firing. Pulse combustion has been shown to be capable of high-intensity burning of coal for acceptably complete combustion within relatively small furnace volumes. It also has inherent capability to agglomerate ash particles in flight, thus rendering them more easily separable from the combustion gas prior to its reaching the pluggage-prone convective section of the boiler or heater. Pulse combustion is also well suited to staged combustion for NO/sub x/ control and has excellent potential for in-furnace SO_2 removal, due to enhanced rates of mass transfer brought about by the flow pulsations. The major elements of the program consists of a review and assessment of the prior art in the area of pulse combustion, a study of potential retrofits of CWM pulse combustors to boilers and heaters, and a laboratory developmentevaluation program. The paper presents the result of the prior art assessment and the retrofit study, both of which have been completed, and the status of the laboratory program, which is presently in progress.

42661 (CONF-850982—, pp 825-836) **Review of the advanced combustion of biomass and coals in York-Shipley's pilot and demonstration fluidized bed combustors.** Korenberg, J.; Carroll, F.; Scaroni, A.W. (York-Shipley, Inc., PA (USA)). 1985. NTIS, PC A99/MF A01. Order Number DE88007794/JAW.

From 2. annual Pittsburgh coal conference; Pittsburgh, PA, USA (16 Sep 1985).

York Shipley currently operates two fluidized bed test units which have been used to acquire combustion data for various coals, petroleum coke and biomass fuels as a first step in the scale-up to production size units. The internal diameters of the pilot and demonstration units are 1 ft and 3.75 ft, respectively. This paper discusses the different modes of operation of the test units including their use as a conventional fluidized bed combustor (FBC), a circulating fluidized bed combustor (CFBC) and as an advanced circulating fluidized bed/cyclone combustor (CFB/CYC). Significant increases in combustion efficiency were effected by operating in the CFB/CYC mode. More significantly, there was an increase of up to one order of magnitude in the volumetric specific heat release rate in the CFB/CYC when compared to operation in the FBC mode. Test data obtained in the pilot and demonstration units burning wood waste, cow manure, petroleum coke, bituminous coal, anthracite, and anthracite culm are presented in this paper.

42662 (CONF-850982—, pp 838-843) **Anthracite culm fired fluidized bed boiler at East Stroudsburg University.** Curran, M.J.; Lentz, E.C. (East Stroudsburg Univ., PA (USA)). 1985. NTIS, PC A99/MF A01. Order Number DE88007794/JAW.

From 2. annual Pittsburgh coal conference; Pittsburgh, PA, USA (16 Sep 1985).

This paper describes operating experience and results of a fluidized bed boiler through the first 4000 hours of operation. Solutions to problems encountered during this period are described. Problem areas discussed in the paper include: finding alternate fuel suppliers; material handling and storage systems; personnel selection, training, and job description changes; and ash disposal. Data to be presented include combustion efficiency, overall efficiency, sulfur and particulate control, and economics on burning culm in terms of acquisition and transportation costs.

42663 (CONF-850982—, pp 844-860) **Combustion of coal volatiles in gas fluidized beds.** Agarwal, P.K.; Wildegger-Gaissmaier, A. (Univ. of Adelaide (Australia)). 1985. NTIS, PC A99/MF A01. Order Number DE88007794/JAW.

From 2. annual Pittsburgh coal conference; Pittsburgh, PA, USA (16 Sep 1985).

In this paper, a detailed model is proposed for the combustion of coal volatiles around individual coal particles in fluidized beds. The hydrodynamics of the fluid bed is considered which permits estimation of the frequency and residence time factors with which the coal particles move alternatively between the bubble and the emulsion phase. These hydrodynamic parameters are linked with the type and size of the bed particles (reflected in the estimation of the minimum fluidization velocity), distributor design (reflected in the estimation of the initial bubble diameter) and total bed height. It is felt that this model provides a more fundamental understanding of how the fluid bed design affects combustion of coal volatiles. 38 references.

42664 (CONF-850982—, pp 861-870) **Theoretical and experimental investigations of heat transfer between gas - fluidized beds and horizontal tubes and their bundles.** Doherty, J.A.; Saxena, S.C. (Univ. of Illinois, Chicago (USA)). 1985. NTIS, PC A99/MF A01. Order Number DE88007794/JAW.

From 2. annual Pittsburgh coal conference; Pittsburgh, PA, USA (16 Sep 1985).

Experiments have been conducted at ambient temperature and pressure to measure the heat transfer coefficient between electrically heated smooth horizontal tubes and their bundles of different sizes and configurations, and fluidized beds of two different size silica sand particles. The heat transfer coefficient is measured in a specially designed 0.305 m sturdy square fluidized bed equipped with a distributor plate having flat top bubble caps with a total open area of 0.2%, and in each case as a function of fluidizing velocity which is varied in the maximum range of 0.2 to 0.9 m/s. Most of the experiments have been conducted with a pressure drop of about 20% of the bed pressure drop and this has always resulted in a well mixed fluidized bed. The slumped bed height is about 50 cm and the tubes are mounted at a height of 19.1 cm and more above the distributor plate. Electrically heated 28.6 mm brass and 50.8 mm aluminum tubes have been used as heat transfer surfaces. As bed materials silica sand of average diameter 488 μm and red silica sand of average diameter 777 μm are employed. Tube bundle configurations of inline and staggered arrangement have been used with the pitch (distance between centers of adjacent tubes) values of 7.62 and 15.24 cm. The bundle size effect is investigated by varying the number of rows and also by locating the heat transfer tube at different positions. Experimental results exhibit the normal qualitative trend of the variation of heat transfer coefficient with fluidizing velocity, particle size and tube diameter. The tube bundle results are compared with the corresponding experimental results for a single tube under otherwise identical conditions.

42665 (CONF-850982—, pp 871-882) **Agglomeration and fragmentation of coal water mixture in a fluidized bed combustor.** Mingjiang, N.; Weihong, L.; Guoquan, H.; Zhongyang, L.; Qian, X.; Kefa, C. (Zhejiang Univ., Hangzhou (China)). 1985. NTIS, PC A99/MF A01. Order Number DE88007794/JAW.

From 2. annual Pittsburgh coal conference; Pittsburgh, PA, USA (16 Sep 1985).

In the industries related to coal production, preparation, transportation and utilization there are many sources of coal water mixture (CWM). Coal water mixtures are usually difficult to dewater because of their high fine particle content. The Combustion Laboratory of Zhejiang University has developed a new technology with which various coal water mixtures can be directly burnt in the fluidized bed combustor with high combustion efficiency. Furthermore, coal water mixture technology has been proved

to be of capable of improving the combustion efficiency of those coals consisting of a large amount of fine particles. To further develop the new technology, knowledge about agglomeration and fragmentation of coal water mixtures in the fluidized bed combustor is necessary because those processes strongly affect the amount of fine fuel particles in the bed which are liable to be blown out of the fluidized bed and form unburnt loss. Moreover, those processes also affect operation stability of the fluidized bed combustor burning coal water mixture. This study was undertaken to investigate agglomeration and fragmentation in a fluidized bed. The paper discusses the influence of bed temperature, fluidizing velocity, water content, injected diameter, size of bed material, size of original coal, and residence time. Conclusions about the mechanism of agglomeration and fragmentation are given. 31 figures.

42666 **(CRANZ-TP—30) Improvements in underfeed stoker operation.** Campbell, R.B. (Coal Research Association of New Zealand, Wellington). 1986. 8p. (CONF-8611235—). Coal Research Association of New Zealand, Wellington, New Zealand.

From New Zealand Hospital Engineers Association conference; No City Given, New Zealand (4 Nov 1986).

The problems associated with clinker formation in the operation of underfeed stokers, and work carried out by Coal Research Association of New Zealand to overcome these problems, are described. The success of this research programme springs from the technologists' better understanding of New Zealand coals. In this case, the operation of stokers is modified to take advantage of the high reactivity of our sub-bituminous coal. Recirculation of about 25% of the flue gas, mixed with the primary air, has the effect of reducing the temperature of the fuel bed and reducing the formation of clinker. Underfeed stokers have, with this modification, been able to operate unattended for fourteen hours, where previously attention may have been required every few hours. 6 figs.

42667 **(ERP/ERL—85-70(TR)) A mathematical model for fluidized bed coal combustion.** Preto, F. (Canada Centre for Mineral and Energy Technology, Ottawa, Ontario). Apr 1985. 147p. CANMET, Ottawa, Ontario.

This report presents a mathematical model for fluidized bed coal combustion which includes submodels for all major processes occuring during combustion. The model is based on the two phase theory for bubbling fluidization. The aim of research in this area is to arrive at a point where experimental results can be generalized, and process analysis and design can be conducted, by means of mathematical models. A numerical simulation of the model has been developed and is included in this report. 16 refs., 5 figs.

42668 **(ERP/MSL—86-89(OP&J)) Potential use of thermal analysis in monitoring fluid-bed combustors.** Mikhail, S.A. (Canada Centre for Mineral and Energy Technology, Ottawa, Ontario). Jun 1986. 9p. CANMET, Ottawa, Ontario.

This paper examines the potential use of thermal analysis in monitoring fluid-bed coal combustors. Samples from the fluid bed, the cyclone, and the baghouse materials were examined to determine the amounts of carbon and $CaCO_3$ to be found in a fluidized bed combustion operation in which limestone was added for sulfur capture. The samples were studied by thermogravimetry and differential thermal analysis which helped in identifying reactions on the basis of weight as well as thermal changes. 8 refs., 7 figs.

42669 **(EUR—11158-FR) Investigations into pollution by fluidised bed boilers.** (Commission of the European Communities, Luxembourg). 1987. 65p. (In French). European Community Information Service, 2100 M St., NW, Suite 707, Washington, DC 20037.

Fluidized-bed combustion is very suitable for high ash and sulfur content fossil fuels but the lower temperatures and excess air tend to promote compounds produced by incomplete combustion. Analysis of fbc residues from Provence coal in CERCHAR's Mazingarbe fbb confirmed low SO_2 and NOx emissions and also indicated: 80% of the nitrogen in the coal is converted into N_2; heavy metals in the ash remain fixed after combustion with the exception of mercury; cleaning of the residue did not cause migration of the metallic compounds in the aqueous phase, hence no water pollution risk; chlorine is weakly fixed by the ash whereas fluorine remains in the ash; and PAHs are produced in small quantities during combustion. The results indicate that fbc is an environmentally acceptable process. 21 refs., 4 figs.

42670 **(EUR—11159-IT) Research on organic compounds in effluent streams from coal-fired power plants.** Bonfanti, L.; Cioni, M.; Donati, B. (Commission of the European Communities, Luxembourg). 1987. 122p. (In Italian). Commission of the European Communities (Luxembourg).

The report covers the following topics: experimental work; determination of organic compounds and PAH in combustion products of coal; light ash in the collectors of electrostatic precipitators (ESP); distribution of organic compounds in the granulometric fraction of ESP ashes; distribution of PAH and of n-alkanes in the granulometric fraction of fly ash; and organic compounds in coal extracts. 24 refs., 25 figs., 19 tabs.

42671 **(NERDDP-EG—87-613) Construction and calibration of the Australian coal combustion testing and research facility.** Baker, J.; Hutton, B. . (National Energy Research, Development and Demonstration Council, Canberra (Australia)). Apr 1986. 115p. Dept. of Resources and Energy, GPO Box 858, Canberra, ACT 2601, Australia.

The Australian Coal Combustion Testing and Research Facility was constructed between May 1984 and November 1985. Calibration testing then commenced in early December 1985 using four coals from Australian power stations. This continued until the 25th April, 1986 at which time calibration testing on three of the coals had been completed and on the fourth coal was substantially completed. The combustion test facility comprises four components: The sample preparation equipment; an off-line mill-capable of use for coal milling performance testing as well as producing batches of pulverised coal for combustion testing; the main test rig with a nominal firing rate of 0.15 MW for testing flame ignitability, stability and burnout, emissivity and heat transfer, slagging and fouling deposits, erosion, gaseous emissions and precipitation; a smaller NO/sub x/ furnace for detailed NO/sub x/ testing on coal. The four calibration coals have been tested for their performance in the above mentioned facilities in terms of their combustion performance, furnace radiation, boiler deposits, erosion in the convective section, gaseous emissions and the performance of the fly ash in electrostatic precipitators and fabric collectors. The results of the performance tests have been compared with the performance of the coals in the power stations. Generally the agreement between the two scales is good and in some instances direct numerical comparisons can be made.

42672 **(NERDDP-EG—87-616) Energy recovery from coal wastes and low quality coals.** Duffy, G.J.; La Nauze, R.D. (National Energy Research, Development and Demonstration Council, Canberra (Australia)). Jun 1986. 89p. Dept. of Resources and Energy, GPO Box 858, Canberra, ACT 2601, Australia.

This report details the final phase of operation of the CSIRO/Joint Coal Board 4.5 MW (thermal) fluidized bed combustor/boiler installation. The fuels fired during the test programme ranged from low ash (2.1%, ad) brown coal briquettes to high ash (73.9%, ad) coarse washery refuse and high moisture (55.3%, as fired) washery tailings. With bituminous coal based fuels, combustion efficiencies up to 96% and boiler efficiencies up to 62% (based on gross specific energy) were measured. No fouling or corrosion problems were evident on either the in-bed tubes or in the convective passes of the waste heat boiler, although measurements of wear rates for the in-bed tubes were inconclusive. The project has demonstrated the viability of generating power from coal washery wastes and low quality coals.

42673 **(RPC—E-87-21) Instruction manual for conductance and dilatometry unit (Ash Testing Unit Model 78911).** Danisch, L. (New Brunswick Research and Productivity Council, Fredericton (Canada)). Mar 1987. 66p. CANMET, 555 Booth St, Ottawa, Ontario, Canada.

The Conductance and Dilatometry Unit measures the temperature at which a significant change in volume or electrical con-

ductance occurs in a lightly compacted sample of coal ash. Designed and built by the New Brunswick Research and Productivity Council for CANMET, the measurements taken by the unit can be used to show the propensity of coals to cause slagging and fouling in furnaces, boilers and the like. 12 figs.

42674 Optical diagnostics for in situ measurements in combustion environments containing coal particles. Hardesty, D.R.; Ottesen, D.K. (Sandia National Laboratory, Livermore, CA (USA)). *Energy (Oxford);* **12**: No. 8/9, 813-836(Aug-Sep 1987).

Much of the recent progress in understanding pulverized coal combustion is attributable to the use of new optical diagnostics for in situ measurements of gas temperatures, concentrations of major and trace gas species, particle-size distributions, particle-surface temperatures, and gas- and particle-velocity fields. In addition, advanced methods, which are now undergoing laboratory development and validation, hold promise for measuring in situ the composition of both entrained particulates and deposits on material surfaces exposed to coal-combustion environments. There is great potential for more widespread application of these techniques in the future, particularly in laboratory bench-scale studies. This paper describes some of the more promising of these new optical methods. The emphasis is on studies of entrained flow environments derived from the combustion of pulverized coal. These environments are hostile with regard to in situ optical interrogation in the sense that they are characterized by high temperatures, high particulate loadings and flow turbulence, and require the use of windows that limit optical path lengths and signal-to-noise ratios. A framework, in terms of two principal classes of flows, for considering the relevance of various techniques in applications involving combustion flows with pulverized coals is presented. The advantages and limitations of in situ methods for a) measuring gas-phase temperatures; b) measuring the major and minor gas species concentrations; c) measuring particulate properties, including sizes, temperatures, velocities, number densities, and flux; d) measuring gas velocities in the presence of a broad distribution of particle sizes are discussed. Special consideration is given to the authors' most recent work on the application of laser spark-spectroscopy for in situ measurement of the elemental composition of entrained particulates. 27 refs., 16 figs.

0150 Marketing And Economics

REFER ALSO TO CITATION(S) 42631, 42693

42675 (EP—55620-20) Market potential of peat pellets in the year 1986. (Ekono, Helsinki (Finland)). 1986. 59p. (In Finnish). Ekono, Helsinki, Finland.

This report studies the market potential of peat pellets with regard to the technical and economic aspects, in building heating and as additional fuel in district heating in 1986. The market potential has been valued according to the marginal prices of pellet firing. On the price level of light fuel in April 1986 the market potential of pellets in building heating is 600,000 t as factory pellets at the price of FIM 260/t. Compared with heavy fuel oil the competitiveness of peat pellets is poor. As additional fuel in district heating the competitiveness of pellets is nearly equally poor. On the basis of the peat pellet production reports of the last few years it is possible to estimate that the price for factory pellets would be FIM 500-600/t and for field pellets FIM 350-450/t. At the above prices the market potential for peat pellets would be about 20,000 t, primarily in the class of 50 kW. The 20% rise in light fuel oil prices would increase the potential by about 50,000 tons, and the corresponding reduction would bring the potential to nil. Regarding the result evaluation it must be noted that the market potential based on marginal price analysis does not yet show in how many cases oil firing would be replaced by firing by pellets. According to the reports made it is probable that at the most a tenth of the annual heating renovators would be willing to change from oil to pellets. In that case the use of pellets would increase at the most 50 000 t/a, and not until 2000 would it be possible to reach the consumption level which in volume would correspond to the total market potential of 1986. In view of the peat pellet production, this report shows that the present production capacity will be adequate for a few years even though the light fuel oil price should rise from the present level.

42676 (ME—24492) Carbon products from peat. (Montreal Engineering Co. Ltd., Toronto, Ontario (Canada)). 30 Apr 1985. 247p. (CE—01649). CANMET/TID, Energy, Mines and Resources Canada, 555 Booth St., Ottawa, Ont., Canada K1A 0G1; $0.34CAN per page, $3.40 CAN minimum.

An estimate of the potential demand for peat carbon products was developed through a literature review and surveys. The objectives were to evaluate commercial operations and processes for producing coke, carbon black, activated carbon, waxes, and tars, and to analyze Canadian markets for such products with a view to determining the feasibility and economic viability of producing such products by the processes surveyed. It was found that the use of peat cokes as a reducing agent is a promising application, but is too expensive compared to alternate cokes. Capital subsidies would be required to make peat coke competitive; subsidies may be justified by the benefits arising from import substituton, as most currently-used cokes in Canada come from the USA. The domestic activated carbon market is too small, and competition too effective, to justify a domestic peat-based activated carbon manufacturer. Peat tars are not suitable as feedstock for carbon black production. Although present market sizes would not justify research identifying the components of peat waxes and tars, such research may open up new market opportunities if any components can be found that have advantages enabling peat-based compounds to compete with lower-cost alternatives. Research would be justified investigating the feasibility of making foundry coke from peat coke, since foundry coke has a premium price and must be imported. 104 refs., 23 figs., 49 tabs.

42677 (MRI—87-7) Peat producers in Canada, 1986 directory. Prud'homme, M. (Department of Energy, Mines and Resources, Ottawa, Ontario (Canada)). 1986. 36p. (In English and French). Printing and Publishing, Supply and Services Canada, Hull, Quebec KIA 059, Canada.

This report provides information regarding the 70 peat producers who were commercially active in Canada during 1986. It contains details on producers such as addresses and bog location, type of peat, grade of peat products, domestic and foreign market destinations and inter- company affiliations. Peat products include bulk material, milled peat, block-cut peat, absorbant, fuel briquettes and soil mixes. More than 90% of Canadian peat production is for use in horticulture.

42678 (NERDDP-EG—87-625) Economic feasibility of producing transport fuels from Australian coals. Palmer, L.D. . (National Energy Research, Development and Demonstration Council, Canberra (Australia)). Sep 1986. 277p. Dept. of Resources and Energy, GPO Box 858, Canberra, ACT 2601, Australia.

Refining of a Morwell brown coal syncrude produced by direct liquefaction has been studied. Australia's three principal transport fuels (gasoline, jet fuel and automotive diesel fuel) can be produced in proportions consistent with future demand patterns. The optimum refining scheme involves a single high severity hydrotreatment of the coal liquid, followed by distillation and naphtha reforming. The cost of refining (excluding liquefaction costs) is approx. 8 c/L greater than refining costs for a light, low sulfur petroleum crude. The high cost of the liquefaction process, rather than the cost of refining, is the main factor inhibiting commercial production of liquid fuels from coal.

0160 Health And Safety

REFER ALSO TO CITATION(S) 42627, 42641

42679 (EUR—10873-EN) Safety in mines. Grisard, R. (Commission of the European Communities, Luxembourg). 1987. 45p. Commission of the European Communities (Luxembourg). Directorate-General Employment, Social Affairs and Education.

Also available in French and German editions.

The Commission of the European Communities decided to allocate a total of 7 500 000 ECU spread over five years from 1976

to the first research programme on safety in mines. Financial aid was granted for 71 research projects. The aim of this summary report to examine the results of the research and to ascertain to what extent solutions were found to the problems. The programme was divided into eight main themes: fires and underground combustion, explosions, rescue, surveillance and telemetry, methods of working, electricity, metallurgy and accidents. The results have been very interesting and encouraging from the point of view of those responsible for technical applications, producers and workers, especially as regards the firedamp and dust explosion risk, the main hazard facing coalminers.

02 PETROLEUM

REFER ALSO TO CITATION(S) 43909

42680 (CPA—1987) Canadian Petroleum Association annual report, 1987. (Canadian Petroleum Association, Calgary, Alberta). 1987. 48p. (EN;FR). (CE—01625). Canadian Petroleum Association, 3800 150 6th. Ave. S.W., Calgary, Alta., Canada T2P 3Y7; $N/C.

This report describes the year's activities of an association whose active membership comprises companies of all sizes engaged in Canada's oil and natural gas exploration, production and pipelining. They produce approximately 90% of Canada's oil and 70% gas, and account for more than 70% of the upstream sector's capital expenditures. A Board of Governors directs the affairs of the association and develops its policies. Policies unique to British Columbia, Saskatchewan, the frontiers and pipelines are addressed by specific divisions. Work which is general to the industry is carried on by 50 standing committees. Information is always available from the standing committees as they carry out their day to day activities. The association provides statistical and technical information and addresses request for information from companies and government agencies. To supplement its statistical and policy activities the association is actively developing an in-house industry cash flow computer model for use in evaluating the impact of fiscal changes on the industry as a whole. The many committees and task forces provide the necessary information for policy formulation. The resulting policies are communicated to governments, regulators, other associations and the public. The association provides a focal point for member companies to develop consensus and for governments and the public to obtain an industry perspective.

0201 Reserves

42681 (OCS/MMS—88-0009) Oil & gas leasing/production program: Annual report/FY 1987. (Minerals Management Service, Vienna, VA (USA). Atlantic OCS Region). 31 Mar 1988. 48p. Unlimited audience, publicly available.. Order Number DE88013114/JAW.

Pursuant to section 15(1) of the Outer Continental Shelf Lands Act (OCSLA), as amended (43 U.S.C. 1343(1), this annual report on the Outer Continental Shelf (OCS) Oil and Gas Leasing and Production Program for Fiscal Year (FY) 1987 is submitted to the Congress of the United States. The document summarizes receipts and expenditures and, in compliance with section 22(g) of the Act, also includes information on OCS safety violations as reported by the US Coast Guard (USCG).

0202 Geology And Exploration

42682 (LTWS—9) Analysis of, and countermeasures against, accidents involving petroleum under the aspect of groundwater protection. Pt. 3. Analytical aspects - sampling, methodology, interpretation. (Bundesministerium fuer Umwelt-, Naturschutz und Reaktorsicherheit, Bonn (Germany, F.R.). Beirat Lagerung und Transport Wassergefaehrdender Stoffe (LTWS); Umweltbundesamt, Berlin (Germany, F.R.)). Mar 1979. 48p. (In German). Umweltbundesamt, Berlin, Germany, F.R.

This volume has two goals. First, experts working in the investigation and analysis of accidents involving petroleum are to be given a survey of the commen methods of analysis. This refers also to those who do not do analyses but must be able to judge the availability and justification of the methods used. (orig./PW)

42683 Arctic Coastal Plain Competitive Oil and Gas Leasing Act. Introduced in the Senate, One Hundredth Congress, Second Congress, Calendar No. 599. Washington, DC; Government Printing Office (1988). 103p.

The Committee on Energy and Natural Resources, having considered the same, reports favorably an original bill, to authorize competitive oil and gas leasing and development on the Coastal Plain of the Arctic National Wildlife Refuge in a manner consistent with protection of the environment, and for other purposes, and recommends that the bill do pass. The Congress declares that it is the purpose and policy of this Act: (a) to authorize competitive oil and gas leasing and development to proceed on the Coastal Plain in a manner consistent with protection of the environment, maintenance of fish and wildlife and their habitat, and the interests of the area's subsistence users; and (b) to provide a new source of funding for acquisition of critical wildlife habitat, for the Land and Water Conservation Fund, and for other purposes.

0203 Drilling And Production

42684 (ACP—071985) Pembina Cardium Field. Enhanced oil recovery economics. Proposed revisions to existing EOR incentives for low productivity reservoirs. O'Keefe, J.J.; Howes, B.J. (Amoco Canada Petroleum Co. Ltd., Calgary, Alberta). Jul 1985. 52p. (CE—01575). CANMET/TID, Energy, Mines and Resources Canada, 555 Booth St., Ottawa, Ont., Canada K1A 0G1; $0.34CAN per page, $3.40 CAN minimum.

Technical analysis of miscibly flooding selected parts of the Pembina Cardium reservoir in Alberta indicates that substantial amounts of additional oil can be recovered, using a hydrocarbon solvent, from areas where little or no conglomerate zone is present. This represents approximately one-half of the total pool. Previous evaluations of the proposed miscible flood projects in the Pembina Cardium Field showed that a substantial enhanced oil recovery potential exists but that such projects were only marinally economic under the conditions that existed at the time. Subsequent to these evaluations, a number of significant changes have occurred. The Western Accord phased-out the Petroleum and Gas Revenue Tax and decontrolled the price of oil, world market forces have reduced oil prices, costs have declined, and a new royalty schedule has been introduced. This report analyzes the Pembina miscible flood economics in light of these changes. The combined effect of the changes is a slight improvement in project economics, which, however, remain marginal. Modifications to the existing Section 4.2 Royalty Deduction and to the earned depletion deduction are proposed with the goal of creating an economic environment that will allow the development of the Pembina Cardium enhanced oil recovery potential. The two projects evaluated in this report represent only a very small portion of the field, 8.3 km/sup 2/ out of field total of 1900 km/sup 2/. If economic considerations permitted the expansion of miscible flooding into the 50% of the Pembina Cardium reservoir considered to be amenable to the current miscible flood design, a very important contribution to oil supplies and economic activity in Canada would result. 6 figs., 26 tabs.

42685 (AEEW-M—2430) Model surfactant studies. 5. The selection of a second model surfactant system. Lee-Tuffnell, C.D. (UKAEA Atomic Energy Establishment, Winfrith). Jun 1987. 11p. British Library Document Supply Centre, Boston Spa, Wetherby, West Yorks. LS23 7BQ.

This memorandum reviews the advantages and disadvantages associated with the use of various surfactants in producing improved phase behaviour in oil, brine and surfactant systems. From previous experience it is deemed necessary that an alternative, single surfactant, model system should exclude alcohol; thus removing the experimental and theoretical complexities associated with alcohol partitioning between the three phases formed. Other highly desirable qualities identified for an alternative surfactant include low or moderate adsorption onto Clashach sandstone, an insensitivity to small changes in both brine concentration and temperature, and an interfacial tension equal to, or less than, 2 x 10/sup -

2/ mNm/sup -1/. Pentaethyleneglycol mono n-dodecyl ether would be a most suitable candidate in future studies on surfactant performance in improved oil recovery.

42686 (AEEW-M—2433) Model surfactant studies. 6. Small angle X-ray and dynamic light scattering studies of surfactant-rich phases from the optimal ternary plane. Lee-Tuffnell, C.D.; Benson, C.G. (UKAEA Atomic Energy Establishment, Winfrith). Jun 1987. 24p. British Library Document Supply Centre, Boston Spa, Wetherby, West Yorks. LS23 7BQ.

Surfactant-rich phases from the single surfactant, model system, optimal pseudo ternary plane have been used to perform surfactant floods to recover pseudo-oil from porous media. it was important to discover whether these phases were micellar, with a brine or oil continuous medium, or non-micellar with a bicontinuous medium. The latter type of phase maximises displacement of oil from porous media by attainment of low interfacial tension between oil and aqueous phases. Dynamic light scattering results reveal particles corresponding to micellar or micellar/bicontinuous structures. Small angle x-ray scattering and electrical conductivity measurements confirm that micelles are present in these phases and that they are in a brine continuous or brine continuous/bicontinuous medium. Calculation of the approximate volume fraction of micelles, 8.0 nm diameter, present in a typical middle phase composition shows that, to account for all the surfactant molecules present, both micelles and bicontinuous structures co-exist in one phase.

42687 (NP—8770260) Characterization of tensides for tertiary recovery of petroleum in highly saline systems using thin film and high performance liquid chromatography. Schuhbauer, W. (Technische Univ. Clausthal, Clausthal-Zellerfeld (Germany, F.R.). Fakultaet fuer Bergbau, Huettenwesen und Maschinenwesen). 11 Mar 1986. 110p. (In German). NTIS (US Sales Only), PC A06/MF A01. Order Number DE88770260/JAW.

Tenside solutions of mixed tensides of the type of alkyl- or alkyl-aryl-polyglycol ether methylene carboxylate proved suitable in laboratory experiments as the flooding medium for tenside flooding in the presence of high alkali or alkaline earth salt contents. Because of the different electrochemical character of the non-ionic and anionic components and their homologous distribution, an analytical total investigation of the mixed tensides of the methylene carboxylated ethoxylate type presents many difficulties. Apart from determining the concentration, a suitable process of analysis should permit information on the degree of conversion, i.e. the ratio of nonionic and anionic facts and the homologous distribution of the ethoxylate to be obtained. From the analysis process tested in this sense (Coulometric titration, two phase titration, infrared spectroscopy, thin film chromatography, and high performance liquid chromatography) the two chromatographic processes proved to be particularly suitable. After previous separation of the tenside mixture from sand, salt water and crude oil, the chromatographic analysis was demonstrated by means of gradient elution on different complex tenside systems. The important proof for the material balance of mixed tensides of non-ionic and anionic components in the presence of crude oil was regarded as satisfactorily provided with a repeated finding rate of about 90%. (orig./RB)

42688 (PRI—071982) Mobility control in heavy oil displacement. First annual report, July 1982-March 1983. Maini, B.B.; Stanislav, P.; Ma, V.; Nicola, F. (Petroleum Recovery Inst., Calgary, Alberta (Canada)). Jul 1982. 117p. (CE—01535). CANMET/TID, Energy, Mines and Resources Canada, 555 Booth St., Ottawa, Ont., Canada K1A 0G1; $0.34CAN per page, $3.40 CAN minimum.

This report presents different aspects of a project investigatng the use of foams in heavy oil displacement. A review of literature is presented, the general conclusion being that the flow of foam in a porous medium is very complex and not well understood. The review also indicates that foam flooding can be successful and can provide incremental oil recoveries with improved efficiencies for steam drives. Foaming capacity and stability measurements were performed on a large number of foaming agents under ambient conditions. Among these, 24 were selected for evaluation under high pressure and temperature conditions. Pressure has only a minor influence on foam stability; however, high temperature has a very detrimental effect. Only a limited number of foaming agents appear to show promise at high temperature. The experimental apparatus design and development of experimental techniques for evaluations of foam rheology in porous media are discussed. Preliminary results of effective viscosity measurements are also presented, confirming the mobility control potential of foams. A literature review on viscous fingering in heavy oil displacement shows most of the reported literature has been concerned with defining the conditions which lead to viscous fingering. Techniques for predicting flood performance in the presence of fingering are not well developed. The results of heavy oil displacement experiments with water and nitrogen injection are presented. The data show that oil/water and oil/gas relative permeabilities change with temperature as well as flow rate of the injected fluids. These changes can be attributed to the viscous fingering phenomenon. 42 refs. 26 figs. 21 tabs.

42689 (PRI—091984) Study of miscible gas flooding. Third annual report, September 1984-March 1985. Sayegh, S.G.; Fosti, J.E.; Najman, J.; Girard, M. (Petroleum Recovery Inst., Calgary, Alberta (Canada)). Sep 1984. 125p. (CE—01562). CANMET/TID, Energy, Mines and Resources Canada, 555 Booth St., Ottawa, Ont., Canada K1A 0G1; $0.34CAN per page, $3.40 CAN minimum.

This project was concerned with investigating nitrogen flooding for petroleum recovery and the use of foams for mobility control in the flooding process. A survey was carried out on Alberta reservoirs to select candidates for nitrogen flooding, indicating a significant amount of target oil available. Phase behavior tests were carried out on a suitable crude oil with nitrogen alone and with various additives, in order to simulate the multiple contact vaporization process. Data indicate that during this process, methane from the oil is vaporized into the gas phase, and during the investigations, phase envelopes and physical property data were measured for oil with nitrogen and with other nitrogen-gas mixtures. Slim tube displacement tests were carried out to supplement the phase behavior data, using nitrogen and nitrogen-carbon dioxide as injection gases. Miscibility was not achieved at up to 34.47 megapascals, but high oil recovery rate using nitrogen-carbon dioxide suggests miscibility may be achieved at pressures not far above 35 megapascals. In the investigation of foams for mobility control, several surfactants were screened, and core floods were conducted to investigate the dependence of foam efficiency on the state of the original fluid, core type, temperature, pressure, and flow rate. The most effective screening test was by bubbling air through their solutions, and the two most effective agents were found to be Empigen BT and Alipal CD-128. 10 refs., 64 figs., 22 tabs.

42690 Split-tapered joint clamping device. Olsen, M.J.; Schwartz, J.F. Jr. (to Dept. of Energy, Washington, DC). US Patent 4,744,692. 17 May 1988. Filed date 22 Sep 1987. vp. Patent and Trademark Office, Box 9, Washington, DC 20232.

A clamping device for removably attaching a tool element to a bracket element is described comprising: the tool element has a slot therein wherein the bracket element is received; a clamp body means having a wedge portion in the slot; a holding means to hold the wedge portion in the slot in wedging engagement with the bracket element and the tool element. The holding means includes a clamping screw extending through openings in the clamp body means and the bracket element; and, the clamp body means has a pivot means so that the clamp body means pivots thereabout on the bracket element as the clamping screw is tightened to force the wedge portion into engagement with the bracket element in the slot.

42691 Hydraulic accumulator-compressor for geopressured enhanced oil recovery. Goldsberry, F.L. (to Dept. of Energy, Washington, DC). US Patent 4,741,398. 3 May 1988. Filed date 30 Dec 1986. vp. Patent and Trademark Office, Box 9, Washington, DC 20232.

Apparatus for pressurization of low pressure, CO/sub 2/ rich, waste gas for use in an enhanced oil recovery system from a

system for recovering pipeline quality gas from geopressured geothermal brine, the pressurization apparatus using the geothermal brine is described comprising: a pipe line connected to a geopressured geothermal well, a vessel having a first end lower than a second end, and having its axis at an acute angle with respect to the horizontal, means at the first end of the vessel for sensing a low geothermal brine level in the vessel, and producing a first signal in response thereto, means at the second end of the vessel for sensing a high geothermal brine level in the vessel, and producing a second signal in response thereto, a pipeline with a check valve for admitting the low pressure, CO/sub 2/ rich, waste gas from the gas source into the vessel at the second end, a pipeline with a check valve for carrying high pressure, CO/sub 2/ rich, waste gas from the vessel at the second end, a pipeline for disposing of liquid connected to the vessel at the first end, and valve means for connecting the first end of the vessel to the geopressured geothermal well pipeline in response to the first signal, and for connecting the first end of the vessel to the disposal pipeline in response to the second signal.

0204 Processing

REFER ALSO TO CITATION(S) 42572, 42585

0205 Products And By-products

42692 **(DGMK—346) Development of selective catalysts for the oxidative coupling of methane to higher hydrocarbons.** Baerns, M.; Silva Palla Carreiro, J.A. da. (Bochum Univ. (Germany, F.R.). Technische Chemie; Deutsche Wissenschaftliche Gesellschaft fuer Erdoel, Erdgas und Kohle e.V., Hamburg (Germany, F.R.)). Aug 1987. 242p. (In German). Deutsche Wissenschaftliche Gesellschaft fuer Erdoel, Erdgas und Kohle e.V., Hamburg (Germany, F.R.).

This project deals with the improvement and further development of catalysts for the oxidative coupling of methane to higher hydrocarbons, particularly ethylene, C/sub 3/- and C/sub 4/-hydrocarbons. Supported PbO catalysts previously described in the literature were improved by using basic support materials and by adding suitable promoters, leading to high selectivities paralleled by a high activity, both being not significantly affected by operation time. A remarkable improvement concerning selectivity, activity and deactivation behaviour was further achieved by introducing basic catalysts containing alkali and alkaline earth compounds. (orig.) With 22 figs., 75 tabs., 99 refs.

0207 Marketing And Economics

REFER ALSO TO CITATION(S) 42681, 43296

42693 **(DOE/EIA—0035(88/03)) Monthly energy review.** (USDOE Energy Information Administration, Washington, DC). Mar 1988. 137p. NTIS, PC A07/MF A01; 1; GPO Dep. Order Number DE88012425/JAW.

The U.S. energy market for the first quarter of 1988 is discussed. Production, energy consumption, imports, price adjustments, and forecasts for the rest of the year are given.

42694 **(DOE/EIA—0109(88/04)) Petroleum supply monthly.** (USDOE Energy Information Administration, Washington, DC). Apr 1988. 112p. NTIS, PC A06/MF A01; 1; GPO Dep. Order Number DE88012414/JAW.

Total U.S. demand for petroleum products dropped nearly 1.1 million barrels per day in April 1988 to 16.4 million barrels per day, about 0.1 million barrels below the level of a year ago. Over 60 percent of the total decrease in product supplied this month was due to an unusually large (0.7 million barrels/day) drop in distillate demand. The disposition of the other major products generated followed observed season trends. Total product stocks increased 13.5 million barrels, from 659.9 million barrels at the end of March to 673.5 million barrels at the end of April. Refinery utilization rose again this month, increasing 0.5 percent to 84.0 percent. As a result of a new, expansive marketing strategy implemented by Iraq, crude oil imports from Iraq during March and April 1988 are triple the average annual rate for 1987.

42695 **(IEE-SR—191) Gas situation in pan-Pacific countries.** (Institute of Energy Economics, Tokyo (Japan)). 31 Jul 1987. 206p. (In Japanese). NTIS (US Sales Only), PC A10. Order Number DE88752077/JAW.

Development, production, consumption and exporting capacity of natural gas and liquefied petroleum gases are outlined for pan-Pacific 9 countries which have potential influence on Japan. As of 1986, Indonesia has export contracts of liquefied natural gas (LNG) of 4 million ton/year with Japan, Malaysia's LNG exports to Japan are 5 million ton/year in 1986 and they will continue to be 6 million ton/year in and after 1987. Burnei's LNG exports to Japan were 5.19 million ton/year in 1985 and would be reduced to 4 million ton/year in 2000 due to remaining reserves. Australia has a plan to export LNG of 6 million ton/year to Japan from 1989. LNG of the U.S. (Alaska) will be exported to Japan at 0.95 million ton/year till 1989. Japan has a joint project with USSR for natural gas development in Yakut and Saghalien in Soviet Far Eastern Region, but it is only at the stage of deliverations. (60 figs, 78 tabs)

42696 **(IEE-SR—193) Price survey on petroleum products in Japan.** Egi, Masahiko; Nihei, Satoru; Jokei, Naohiro. (Institute of Energy Economics, Tokyo (Japan)). 15 Aug 1987. 234p. (In Japanese). NTIS (US Sales Only), PC A11/MF A01. Order Number DE88770150/JAW.

In spite of the recent downward trend of share of petroleum in the primary energy, the trend of petroleum in the primary energy, the trend of petroleum prices in the industry and society is as yet important. Only few reports on the petroleum prices are, however, presented. This report of 225 pages analyzes various factors which are related with the price formation. Major points are as follows. Part 1 deals with the price system of the Japanese petroleum products (History of price formation in Japan. Changes in the price system and calculation of effects by the production structure and the petroleum refinery model). Part 2 describes the cases in the western countries concerning the position of petroleum as the primary energy, petroleum policy, market characteristics, and the mechanism of price formation. (53 figs, 124 tabs)

0208 Waste Management

REFER ALSO TO CITATION(S) 43603

42697 (CONF-871075—Vol.1-Pt.3, pp 267-277) **Recent technology developments for PCB destruction and oil recycling.** Woodyard, J.P.; King, J.J. (IT Corp., Oak Ridge, TN (USA)). 1987. NTIS, PC A18/MF A01. Order Number DE88007805/JAW.

From 3. Oak Ridge model conference on waste problems; Oak Ridge, TN, USA (13 Oct 1987).

This paper discusses the status of two newly commercialized processes for treating PCB, the KPEG process for PCB treatment, and a reagent process for treating PCB on surfaces and in concrete. The KPEG process has already been permitted for full-scale use in USEPA Region II and New York State and is currently scheduled for a national TSCA mobile treatment permit demonstration in October. The process has also been used commercially to treat PCB and dioxin contamination in waste oils as part of several major Superfund projects, illustrating that its versatility in handling waste contaminated with water, solids, and other contaminants are conducive to treatment by other available processes. The paper includes several case studies in which different waste materials have been treated successfully and identifies plans for second and third generation technology designs for commercial deployment. The reagent is applied in a heated liquid form and allowed either to penetrate porous surfaces or coat non-porous surfaces. The technique provides a significant advantage in many instances; for concrete it allows destruction of PCB in place without concrete removal, while on metal or other non-porous surfaces it can be used to reduce or eliminate the need for PCB disposal of decontamination residues.

0209 Environmental Aspects

42698 **(BA—EE54) Remote sensing equipment for chronic oil discharges.** (Bercha (F.G.) and Associates Ltd., Ottawa, Ontario (Canada)). Aug 1984. 393p. (CE—01565). CANMET/TID, Energy, Mines and Resources Canada, 555 Booth St., Ottawa, Ont., Canada K1A 0G1; $0.34CAN per page, $3.40 CAN minimum.

The purpose of this study was to document the capability of remote sensing systems to monitor chronic oil discharges. The investigation was limited to state-of-the-art equipment and techniques that have the potential for adaptation as vessel or rig mounted systems with routine monitoring capabilities. To accomplish this a comprehensive literature search was conducted. This information was documented and candidate sensor systems identified. The candidate sensors were quantified in terms of detection limits, sensing range, environmental restrictions, adaptability to rig or vessel mounting and operating limitations. The subsequent step was to evaluate the sensors in terms of operating scenarios where accidental or chronic oil and production waste discharges could occur. Based on these results, recommendations are extrapolated regarding sensor/technique utility for the following three categories: operation, theoretically usable but untested, and new technology with high potential. The resulting, suitable sensor package and its installation are discussed. For visible discharges, photographic and television cameras are readily adaptable to operation on ground-base platforms. There are no systems that provide all-weather capability, but passive microwave devices appear to have the highest potential. For invisible discharges, detection may be impossible, and further research is needed. Some kind of laser-based system seems to have the highest potential. An annotated bibliography of selected reports and papers reviewed for this study occupies about half of the report. A glossary is also included. 27 refs., 29 figs., 29 tabs.,

42699 **(CONF-880679—7) Assessing inhalation risks from the land treatment of petroleum refining wastes.** Fingleton, D.J.; Oezkaynak, H. (Argonne National Lab., IL (USA); Harvard Univ., Cambridge, MA (USA). Energy and Environmental Policy Center). 1988. Contract W-31-109-ENG-38. 18p. NTIS, PC A03/MF A01; 1; GPO Dep. Order Number DE88012069/JAW.

From 81. annual meeting of Air Pollution Control Association; Dallas, TX, USA (1 Jun 1988).

Careful consideration must be given when selecting the atmospheric transport model to be used in the land treatment case. Even though there is a long history of use for the ISCLT model and it has been given EPA approval for these types of modeling situations, the timescales and processes acting in a land treatment unit may invalidate the model for this use. Clearly, for highly volatile chemicals, emissions are high during application, decays rapidly for the first few hours, then slowly decreases with time. Under these circumstances short-term models should be applied. However, even the ISC-short term (ISCST) model may not have the temporal and spatial resolution to properly characterize these short duration pulses. Ultimately models should be developed that couple, probabilistically, application patterns such as time of day or month; various precipitation events either before or after application; short-term wind flow and stability variations; as well as other parameters or operational characteristics.

0220 Transport, Pipelines, And Handling

42700 **(CMI-R—872310-1) Coordinated transport of oil and gas. Principles of cost allocation.** Fagerli, L.; Hallefjord, Aa.; Papahristodoulou, C. (Christian Michelsens Inst. for Vitenskap og Aandsfrihet, Bergen (Norway)). Nov 1987. 73p. (In Norwegian). NTIS (US Sales Only), PC A04/MF A01. Order Number DE88752099/JAW.

The problem is studied how to allocate common investment costs in coordinated transport of oil and gas. With a requirement of full covering of the costs, it is not always possible to obtain economic efficiency for the society, because transport of petroleum products is an activity with pronounced large-scale operation advantages. It is proposed here to use cooperative game theory to obtain good solutions of the cost allocation problem, and it is illustrated how the theory can be applied in various cases. 10 refs.

0230 Properties

42701 **(LU/GM—J0143) On the vapour pressures of hydrocarbons.** Odgers, J.; Kretschmer, D.; Poirier, D. (Laval Univ., Quebec City (Canada). Dept. de Genie Mecanique). Jan 1985. 84p. (CE—01574). CANMET/TID, Energy, Mines and Resources Canada, 555 Booth St., Ottawa, Ont., Canada K1A 0G1; $0.34CAN per page, $3.40 CAN minimum.

A technique has been developed for the simultaneous measurement of fuel vapor pressure and the quantity of dissolved air in the fuel, providing that conditions are selected such that the vapor pressure is a considerable fraction of the total pressure. The technique has been proven by the measurement of the vapor pressure of pure substances which were capable of being accepted as being standards. Further confirmation was obtained by comparing the measured values of simple mixtures (up to 5 components) with the calculations using Raoult's and Henry's Laws. The solubility constants determined using the present technique have been shown to be in reasonable agreement with published values obtained by other workers using different techniques. In order to give the maximum information possible, this report describes not only the specified tests, but also the development of both the theoretical and practical aspects of the methodology. 9 refs., 51 figs., 5 tabs.

42702 **Solubilities of methane, ethane, and carbon dioxide in heavy fossil-fuel fractions.** Schwarz, B.J.; Prausnitz, J.M. (Materials and Chemical Sciences Div., Lawrence Berkeley Lab., and Chemical Engineering Dept., Univ. of California, Berkeley, CA (US)). *Industrial and Engineering Chemistry Research;* **26**: No. 11, 2360-2366(Nov 1988).

Measurements are reported for the solubilities of methane, ethane, and carbon dioxide in six characterized fossil-fuel fractions. The fractions from crude oils and coal liquid have initial boiling points between 589 and 700 K. Solubilities were measured in a semibatch equilibrium cell at pressures between 5.8 and 21 bar and temperatures from 374 to 575 K. An equation of state was used to determine Henry's constants from the solubility data. These solubility data may be useful for testing correlations used in process-design calculations.

42703 **Vapor pressures and saturated-liquid densities of heavy fossil-fuel fractions.** Schwarz, B.J.; Wilhelm, J.A.; Prausnitz, J.M. (Materials and Molecular Research Div., Lawrence Berkeley Lab., and Chemical Engineering Dept., Univ. of California, Berkeley, CA (US)). *Industrial and Engineering Chemistry Research;* **26**: No. 11, 2353-2360(Nov 1988).

Measurements are reported for vapor pressures and saturated liquid densities of characterized fossil-fuel fractions. Vapor pressures were measured for 12 fractions and densities for 30 fractions. The fractions originated from crude oils, coal liquid, and tar sands. Initial atmospheric boiling points of the fractions range from 492 to 700 K. Vapor pressures to 575 K were measured by using an ebulliometer; between 1 and 7 wt % of the sample was vaporized during these measurements. Saturated liquid densities were measured between 292 and 578 K by using sealed glass cells heated in an air bath. For most samples, the measured properties showed only small observable effects of cracking. The data reported may be useful for testing correlations used in process-design calculations.

42704 **Molecular weight distributions for heavy fossil fuels from gel-permeation chromatography and characterization data.** Rodgers, P.A.; Creagh, A.L.; Prange, M.M.; Prausnitz, J.M. (Materials and Molecular Research Div., Lawrence Berkeley Lab., and Chemical Engineering Dept., Univ. of California, Berkeley, CA (US)). *Industrial and Engineering Chemistry Research;* **26**: No. 11, 2312-2318(Nov 1988).

A correlation is presented for calculating molecular weight distributions for high-boiling hydrocarbon mixtures from measurements using gel-permeation chromatography (GPC). The correlation uses GPC elution volume, hydrogen-to-carbon ratio from elemental analysis, and hydrogen distribution from H NMR spectroscopy. Results for 45 pure hydrocarbons give an average deviation

of less than 4%. For application to fractions, the procedure is illustrated with results for an Alaskan North-Slope residue. Characterization data are reported for 13 heavy fossil-fuel fractions, including coal-liquefaction products and crude oils.

42705 **Diazido alkanes and diazido alkanols as combustion modifiers for liquid hydrocarbon ramjet fuels.** Miller, R.S.; Moriarty, R.M.; Law, C.K. (to Secretary of the Navy, Washington, DC). US Patent 4,741,742. 3 May 1988. Filed date 3 Jul 1986. vp. Patent and Trademark Office, Box 9, Washington, DC 20232.

A liquid hydrocarbon ramjet fuel is described comprising from more than zero to 100 weight percent of a diazido alkanol of the general formula N/sub 3/CH/sub 2/(CH/sub 2/)/sub chi/CHOH(CH/sub 2/)/sub y/CH/sub 2/N/sub 3/ wherein chi is an integer of from 0 to 9, y is an integer of from 0 to 19, chi+y is an integer of from 0 to 19, and chi≦y, and the balance being a conventional jet fuel.

42706 **Identification of novel bicyclic alkanes from steroid precursors in crude oils from Kelamayi oil field of China.** Zhusheng, J.; Philp, R.P.; Lewis, C.A. (Univ. of Oklahoma, Norman (USA)). *Geochimica et Cosmochimica Acta;* **52**: No. 2, 491-498(Feb 1988). Contract FG05-85ER13412.

A novel series of bicyclic alkanes in the C_{19}-C_{22} range has been discovered in a number of crude oils from a variety of sources. Evidence is provided from laboratory studies to demonstrate that there is a correlation between these bicyclic alkanes and steranes, suggesting in turn that both series of compounds are actually derived from sterol precursors. These bicyclic alkanes appear to be resistant to the effects of biodegradation which in turn enhances their concentration in biodegraded oils following removal of other less resistant compounds. The value of this stability is demonstrated in the correlation of an oil and seep from the Anadarko Basin. The seep is biodegraded such that all regular steranes are removed leaving only rearranged steranes compared with an oil where all steranes are intact. The bicyclic alkane distributions are similar for both samples demonstrating their potential for correlation purposes. The effect of maturation on these components was not evaluated in detail in this particular study.

0250 Combustion

REFER ALSO TO CITATION(S) 42661

42707 (GULF/C—121983) **Study of effect of low cetane number fuel on a diesel engine; preliminary runs on the Detroit Diesel 6V92TT Engine.** LeGresley, D.M.B.; Lewis, W.E.; Deutscher, R.R. (Hans Ahlstrom Lab. (Canada)). Dec 1983. 48p. (CE—01642). CANMET/TID, Energy, Mines and Resources Canada, 555 Booth St., Ottawa, Ont., Canada K1A 0G1; $0.34CAN per page, $3.40 CAN minimum.

Test runs with a Detroit Diesel Allison 6V92TT turbocharged engine equipped with standard injectors were made on four test fuels: conventional No. 2 diesel--cetane No. 47.2, 1990 type diesel--cetane No. 33.5, 1990 diesel + 0.05% DII-3(Ethyl cetane improver)--cetane No. 36.3, and 1990 diesel + 0.10% DII-3--cetane No. 37.4. Operating temperatures and pressures, fuel mass flow, cylinder pressure in one cylinder, strain gauge measurements from the rocker arm operating one injector, engine speed and load, and exhaust compositions were recorded to monitor engine performance. It was noted that the lower cetane fuels had longer ignition delay periods, higher peak cylinder pressures and higher maximum rates of cylinder pressure increase. Over the short test duration, no operating problems were encountered as a result of the low cetane fuel. NO/sub x/ emissions increased with load corresponding to increases in combustion zone temperatures while the fuels containing the cetane improver generally had lower NO/sub x/ emissions than the base blend fuel. 3 refs., 25 figs., 10 tabs.

42708 (LU/GM—J0134) **The prediction of gas turbine combustor performance due to changes in fuels. 9, weak extinction characteristics.** Odgers, J.; Kretschmer, D.; Poirier, D. (Laval Univ., Quebec City (Canada). Dept. de Genie Mecanique). Jun 1984. 39p. (CE—01558). CANMET/TID, Energy, Mines and Resources Canada, 555 Booth St., Ottawa, Ont., Canada K1A 0G1; $0.34CAN per page, $3.40 CAN minimum.

A series of reports have been written predicting the effects of alternate fuels upon the combustion performance of gas turbine combustors. This, the ninth and final report in the series, describes attempts to predict the extinction behaviour of aircraft engine combustors. The report addresses the problems of defining the reaction zone in the combustor, the air-fuel ratios within the reaction zone, and the state of the liquid fueld and degree of mixedness. Attempts are made to correlate weak extinction behavior with mathematical predictions that take reaction rates, droplet characteristics and diffusion processes into account. Based on published operating conditions and using physical data for various fuels as presented in previous reports in this series, the extinction values (lean limits) were predicted according to equations evaluated in this report against previously published data. 8 refs, 13 figs., 13 tabs.

42709 (NISAN—8701, pp 52-59) **Analysis on the vaporization process of multi-component fuel droplets.** Yamamoto, Tadahiro; Ota, Tadaki; Iwano, Hiroshi. (Nissan Motor Co., Ltd., Tokyo, Japan). 25 Apr 1987. (In Japanese). Nissan Motor Co. Ltd., Tokyo, Japan.

In Nissan Technical Review, Transaction.

For gasoline engine fuel supply systems with an intake manifold, fuel vaporization can be realized more quickly through reduction of fuel droplet's size in the intake manifold. There are many studies as to fuel droplet vaporization, but they all assume gasoline to be a single component such as isooctane. Initially this research analyzed the difference in vaporization characteristics between gasoline and isooctane through experiments with a simple model. Then a calculation which assumed that gasoline consisted of 4 components was conducted; the characteristics of vaporization process were clarified; and factors related to good gasoline vaporization were analyzed. It was verified that this method could predict more accurately the gasoline vaporization. (10 figs, 5 tabs, 6 refs)

03 NATURAL GAS

REFER ALSO TO CITATION(S) 42680

0301 Reserves

REFER ALSO TO CITATION(S) 42681

42710 (CONF-8706191—, pp 23-31) **Natural gas resources in northern Alaska.** Sharma, G.D. (Univ. of Alaska, Fairbanks (USA)). Sep 1987. NTIS, PC A 06. Order Number DE88006898/JAW.

From Alaskan gas utilization workshop; Fairbanks, AK, USA (30 Jun 1987).

Commercial natural gas occurrence can be broadly classified into two categories, conventional and unconventional. The conventional category includes natural gas found as associated and non-associated or free gases, including dissolved or solution. The unconventional natural gas resource includes, (1) deep gas, (2) coal bed methane, (3) gas hydrates and gas in (4) shales, (5) geopressurized aquifers and tight sands. With the exception of gas hydrates very little information for unconventional natural gas resources in Alaska is available. Most oil fields discovered in northern Alaska have associated gas. While all have dissolved gas some have large gas caps. The production histories of these fields have now provided the amount of natural gas available and thus can be labeled as proven reserves. The current production of dissolved natural gas from some of these fields, in processed or unprocessed form, is reinjected into the field. This analysis concludes that northern Alaska has 36.9 trillion cubic feet (TCF) of natural gas as proven reserves. Preliminary studies of gas hydrates suggest that this unconventional resource could provide 500 TCF of gas.

0302 Geology And Exploration

REFER ALSO TO CITATION(S) 42683, 42716

0303 Drilling, Production, And Processing

REFER ALSO TO CITATION(S) 42690, 42713

42711 **(BUR—041985) An energy audit strategy for gas plants. Final report.** Paskall, H.G.; Ritter, R.A.; Sames, J.A.; Dale, P.R. (Bow Valley Research Ltd., Calgary, Alberta (Canada)). Apr 1985. 60p. (CE—01564). CANMET/TID, Energy, Mines and Resources Canada, 555 Booth St., Ottawa, Ont., Canada K1A 0G1; $0.34CAN per page, $3.40 CAN minimum.

The objective of this project was to develop a versatile, easily applied energy audit strategy that had the widest possible applicability to natural gas processing plants. Energy audits were carried out on three Alberta gas plants having different raw gas feed compositions in order to evolve an audit strategy. The resulting strategy is cyclic in nature, being first applied to obtain an overview of energy distribution and usage and then reapplied in the rank order of the energy consumptions. Cycles are continued until all significant energy consumptions have been identified and documented. A simple conceptual model for applying the energy audit strategy to natural gas processing plants was developed. Descriptions of the overall strategy cycles, and a detailed procedure for carrying out each cycle, are presented. The first cycle application of the audit procedure yields the overall energy distribution within the plant and the overall energy recovery efficiency. For the three plants audited, the overall energy recovery efficiencies were virtually the same, 86%. For one plant, the audit results indicated certain remedial actions that will increase the overall energy recovery by 2%, with possiblility for a further 2% increase. In principle, there are no limiations to the overall strategy. However, the methods and procedures used to obtain the data upon which the audit is based do have practical limitations. 9 refs., 18 figs., 6 tabs.

0306 Marketing And Economics

REFER ALSO TO CITATION(S) 42681, 42693, 42695, 42718, 42719

42712 (CONF-8706191—, pp 32-34) **Alaska Oil and Gas Conservation Commission perspective.** Chatterton, C.V. Sep 1987. NTIS, PC A 06. Order Number DE88006898/JAW.

From Alaskan gas utilization workshop; Fairbanks, AK, USA (30 Jun 1987).

This paper briefly discusses the advantages of reinjecting the associated gas being produced at Prudhoe Bay oil fields to enhance the production of oil rather than finding an economic way to ship the gas to consumers in the south. Even after production at Prudhoe Bay declines, the gas could still be used for enhancing production in other oil fields north of Brooks Range.

42713 (CONF-8706191—, pp 45-47) **Gas Processors Association perspective.** Kirk, E. Jr. Sep 1987. NTIS, PC A 06. Order Number DE88006898/JAW.

From Alaskan gas utilization workshop; Fairbanks, AK, USA (30 Jun 1987).

The author comments on major concerns of owners of gas resources regarding opportunities to utilize their reserves, on political and legal issues involved between individual owners of gas reserves in Alaska (drainage), as it has to do with size and limits of reservoirs and EOR injection issues. Other subjects for comments were to the effect of the length of time that a company could reinject gas without causing production problems or reducing ultimate recovery of the resource, and the factors to be considered in liquids conversion or other utilization alternatives.

42714 (CONF-8706191—, pp 53-54) **Mountain Alaska Energy, Inc. perspective.** Sitter, L.D. Sep 1987. NTIS, PC A 06. Order Number DE88006898/JAW.

From Alaskan gas utilization workshop; Fairbanks, AK, USA (30 Jun 1987).

The current condition of the economy of both the state of Alaska and the Lower-48 states provides an opportunity to develop both a new utility system and a new methodology for delivering natural gas to fuel a local distribution system: transporting Compressed Natural Gas (CNG) by sea. Factors which support this conclusion are discussed.

42715 (CONF-8706191—, pp 55-58) **Will Alaska gas ever get to market.** Tussing, A. (Univ. of Alaska, Anchorage (USA)). Sep 1987. NTIS, PC A 06. Order Number DE88006898/JAW.

From Alaskan gas utilization workshop; Fairbanks, AK, USA (30 Jun 1987).

It is just about ten years since the President and Congress, together with the Government of Canada, approved construction of a $40-billion natural-gas pipeline linking the Alaska North Slope with the existing interstate pipeline grid in the Lower-48. That pipeline (the Alaska Natural Gas Transportation System or ANGTS) has not, of course, been built. The reasons for its failure are discussed. The state of the natural gas industry and alternatives for the use of North Slope gas are described. Gas injection for enhanced petroleum production, conversion to gasoline, and conversion to methanol fuels are three alternatives briefly discussed.

0309 Artificial Stimulation

42716 **(DOE/MC/21179—2564) Rock matrix and fracture analysis of flow in western tight gas sands: Annual report, Phase 3.** Dandge, V.; Graham, M.; Gonzales, B.; Coker, D. (New Mexico Inst. of Mining and Technology, Socorro (USA). New Mexico Petroleum Recovery Research Center). Dec 1987. Contract AC21-84MC21179. 118p. NTIS, PC A06/MF A01;1; GPO Dep. Order Number DE88001063/JAW.

Tight gas sands are a vast future source of natural gas. These sands are characterized as having very low porosity and permeability. The main resource development problem is efficiently extracting the gas from the reservoir. Future production depends on a combination of gas price and technological advances. Gas production can be enhanced by fracturing. Studies have shown that many aspects of fracture design and gas production are influenced by properties of the rock matrix. Computer models for stimulation procedures require accurate knowledge of flow properties of both the rock matrix and the fractured regions. In the proposed work, these properties will be measured along with advanced core analysis procedure aimed at understanding the relationship between pore structure and properties. The objective of this project is to develop reliable core analysis techniques for measuring the petrophysical properties of tight gas sands. Recent research has indicated that the flow conditions in the reservoir can be greatly enhanced by the presence of natural fractures, which serve as a transport path for gas from the less permeable matrix. The study is mainly concerned with the dependence of flow in tight gas matrix and healed tectonic fractures on water saturation and confining pressure. This dependency is to be related to the detailed pore structure of tight sands as typified by cores recovered in the Multi-Well experiment. 22 refs., 34 figs., 9 tabs.

0310 Legislation And Regulation

42717 (CONF-8706191—, pp 41) **Pipeline right-of-way bill.** Coghill, J.B. Sep 1987. NTIS, PC A 06. Order Number DE88006898/JAW.

From Alaskan gas utilization workshop; Fairbanks, AK, USA (30 Jun 1987).

Prior to the recent passage of SB 108, under AS 38.35.100(b), the Commissioner of the Department of Natural Resources was required to make the determination that the applicant was fit, willing and able to perform the transportation prior to issuance of a right-of-way lease permit. Past interpretation of this standard meant that any applicant must have the financial capability to go forth with the project which would utilize the right-of-way. In today's world a right-of-way permit has a value all its own when negotiating financing. To make financing a condition of the ROW

lease application hampered a project's chances of becoming a financial reality. This bill amends the Right-of-Way Leasing Act so that the Commissioner can condition a grant of right-of-way so that the applicant can receive the right-of-way but must demonstrate that it is fit, willing and able prior to being allowed to start construction on that right-of-way. The current standard of fit, willing and able is not circumvented but the finding is postponed to a later phase in the process.

0320 Transport, Pipelines, And Handling

REFER ALSO TO CITATION(S) 42700, 42714, 42715

42718 (CONF-8706191—, pp 37-39) **Alaska natural gas transportation system perspective.** Wadlington, C. Jr. Sep 1987. NTIS, PC A 06. Order Number DE88006898/JAW.

From Alaskan gas utilization workshop; Fairbanks, AK, USA (30 Jun 1987).

The Alaska natural gas transportation system (ANGTS) is a 4800-mile pipeline system which would traverse from the North Slope of Alaska across Canada to Chicago and San Francisco, to deliver natural gas to 48 of the 50 states. Historical and legal aspects of the development of the ANGTS are described. The author states that the only market for Alaskan gas that makes economic sense is the United States. These economics are briefly discussed.

42719 (CONF-8706191—, pp 50-52) **Foothills Pipe Line (Yukon) Ltd. perspective.** Jespersen, C.K. Sep 1987. NTIS, PC A 06. Order Number DE88006898/JAW.

From Alaskan gas utilization workshop; Fairbanks, AK, USA (30 Jun 1987).

Foothills is the Canadian sponsor of the Alaska Natural Gas Transportation System, the 5000-mile pipeline project. Foothills itself owns and operates approximately 530 miles of pipeline which extends from a point in south central Alberta, near the town of Caroline, to two points on the international border with the US. The entire system of Foothills, like the Northern Border System and portions of the PGT System in the US, is an integral part of the ANGTS. This paper discusses the future energy needs of North America, the progress already made in connection with the ANGTS in meeting those needs, and the market for natural gas.

0350 Storage

42720 **(CRIE-U—86050) Mechanical behaviour of ring type reinforced concrete members with lap splices.** Kanazu, Tsutomu; Aoyagi, Yukuo; Endo, Tatsumi; Ishida, Hiroaki. (Central Research Inst. of Electric Power Industry, Tokyo (Japan)). May 1987. 42p. (In Japanese). NTIS (US Sales Only), PC A03/MF A01. Order Number DE88770149/JAW.

In the construction of deep underground structures, the continuous underground wall method is generally used to prevent water stream in the ground and collapse of the earth wall. In pursuit of an efficient construction method, an attempt is made to apply a continuous wall to a main structure to perform part of the load bearing function. Static load tests and destructive tests are made for ring type reinforced concrete (RC) members with lap splices using a loading method which takes earthquake loads into account. Up to the yield point of main reinforcement, the ring type RC members with lap splices showed deformation behaviors similar to those of reinforced continuous concrete. After the yield point of reinforcement, splitting cracks due to bond failure occur at portions where lap slices are embedded, but this does not lead to rapid deformation of structures. Compared to reinforced continuous concrete, the ring type RC members are slightly inferior in load bearing performance but comparable in toughness. These results indicate that the continuous RC wall can be applied to structural members. (34 figs, 7 tabs, 7 refs)

04 OIL SHALES AND TAR SANDS

REFER ALSO TO CITATION(S) 42680

0404 Oil Production, Recovery, And Refining

REFER ALSO TO CITATION(S) 42572

0405 Properties And Composition

REFER ALSO TO CITATION(S) 42703

0409 Waste Research And Management

42721 **(MC/C—IP5) Characterization and treatment of emissions from a mining oil sands complex. 2 Vols.** (Monenco Consultants Ltd., Calgary, Alberta (Canada)). Feb 1985. 285p. (CE—01616). CANMET/TID, Energy, Mines and Resources Canada, 555 Booth St., Ottawa, Ont., Canada K1A 0G1; $0.34CAN per page, $3.40 CAN minimum.

The major objective of this study is to provide information on the characteristics of gaseous, liquid and solid waste emissions and upgrading and utility process options associated with a mining oil sands complex. The process options considered are those which are commercially proven for handling Athabasca oil sands and bitumen or which show commercial promise. Waste management information is specifically provided for different process configurations making up 15 different oil sands complexes, then producing 20,000 m/sup 3//d of synthetic crude and five producing 3,000 m/sup 3//d. Information on the handling and required treatment of gaseous, liquid and solid waste emissions for each of the 15 complexes is also provided, together with associated treatment costs. For each of the 15 complexes, a summary of conversion efficiency from oil sands to synthetic crude, the sulphur balance and the water balance are given. The process and waste management information contained in this report was obtained from detailed review of the available literature, in-house information, calculations and mass balances based on materials composition, and licensor information. A review of the waste management data in this report indicates that there are significant data gaps, notably in emission and wastewater characterization, waste management processes under upset conditions, and wastewater treatment and recycle. Also, there is a lack of technology and experience in utilization of solid residues and flue gas treatment. 110 refs., 88 figs., 104 tabs.

0410 Environmental Aspects

42722 **X-ray photoelectric spectroscopy determination of a conceptual leaching model of retorted oil shale.** Feerer, J.L.; Miller, A.G.; Ramirez, W.F. (Univ. of Colorado, Boulder (USA)). *Environmental Science and Technology;* **20**: No. 7, 695-702(Jul 1986). Contract AC02-83ER60121.

Two hypotheses are proposed to describe the leaching of solid wastes. One hypothesis involves formation of a leached zone around particles of solid waste in contract with water, resulting in a diffusion barrier to release of soluble pollutants. The other hypotheses relies on pore diffusion and surface reaction as the dominating mechanisms controlling leachate release. X-ray photoelectric spectroscopy (XPS) is used to help determine which model more closely describes leaching of retorted oil shale. Although some evidence of possible $Al(OH)_3$ precipitation and relative depletion of sodium on the surface is found, a leached zone is apparently not formed on retorted oil shale during leaching. 34 references, 5 figures, 6 tables.

05 NUCLEAR FUELS

0501 Reserves, Exploration, And Mining

42723 **(INIS-BR—1148) Geochemical Survey of Pernambuco.** Horowitz, A.; Duarte, P.J.; Almeida, M.G. de; Medeiros, M.O. (Pernambuco Univ., Recife (Brazil). Dept. de Energia Nuclear). [1988]. 24p. (In Portuguese). NTIS (US Sales Only), PC A03/MF A01. Order Number DE88703551/JAW.

The area studied i this work is located in a triangle formed by the Sibiro and Boca da Mata Sugar-Mills and Serinhaem country. In the Cabo Formation the search determinated conglomerates, arcos and clays. Although the highest geochemical activity have been done in the decomposed crystalin, and the values from Cabo Formation don't be encourager, this formation has lithology compatible with uranium mineralization. The Cabo Formation's sediments presents lithologic variations very expressives, with conglomerates, arcoses and clay silts, which determinate the choise of the area. This area presented favorable to uranium prospecting and to others elements interesting to ragional geochemistry. The atomic absorption analysis, fluorimetry and spectrometry were done for the following elements: Zn, V, Ti, Ni, Pb, Mn, Ga, Cu, Co, Bi, Ag, B, Mo, and U. (C.D.G.).

42724 (INIS-mf—11210, pp VI14-VI17) **Assay-system design for borehole logging of uranium.** Vulkan, U.; Ben-Haim, Y. (Israel Atomic Energy Commission, Yavne. Soreq Nuclear Research Center; Technion-Israel Inst. of Tech., Haifa. Dept. of Nuclear Engineering). Dec 1987. NTIS (US Sales Only), PC A13/MF A01. Order Number DE88780087/JAW. (CONF-871287—).

From Nuclear Societies of Israel annual meeting; Haifa, Israel (21 Dec 1987).

Transactions.; V. 14.

0504 Feed Processing

REFER ALSO TO CITATION(S) 42767, 43480

42725 **(FMPC—2135) Feed Materials Production Center: Environmental monitoring annual report for 1987.** (Westinghouse Materials Co. of Ohio, Cincinnati (USA). Feed Materials Production Center). 30 Apr 1988. Contract AC05-86OR21600. 191p. NTIS, PC A09/MF A01;1; GPO Dep. Order Number DE88010509/JAW.

Routine environmental monitoring is conducted at the Feed Materials Production Center (FMPC) and surrounding areas to make sure that radiation protection standards and federal and state standards regulating the discharge of radioactive and nonradioactive pollutants are met. In addition, releases of radioactive, toxic, and hazardous materials are maintained as far below standards as reasonably achievable. Dose calculations show that there were no harmful effects to the public and the environment from FMPC operations in 1987. Estimated doses to the public were well below standard values, and all but a few areas that were sampled showed radionuclide concentrations within the range of concentrations expected for naturally-occurring radionuclides. New studies and additional control measures have enabled the FMPC to further evaluate the environment, and to institute additional remedial actions. New methods and programs will be added to continue to reduce emissions and exposures. 21 refs., 49 figs., 47 tabs.

42726 **(INIS-BR—994) Study for uranium advantage as byproduct of the phosphorite from Brazilian Northeast.** Almeida, M.G. de. (Sao Paulo Univ. (Brazil). Inst. de Quimica). 1974. 85p. (In Portuguese). NTIS (US Sales Only), PC A05/MF A01. Order Number DE88702578/JAW.

The distribution and recovery of uranium contained in marine phosphates from Northeast Brazil were investigated by treating these ores with hydrochloric acid. The average content of uranium in the phosphorite was found to be about 0.03%. The leaching of phosphate from the ore and the amount of solubilized uranium supplied the basic information for the uranium recovery. The solutions, obtained in laboratory, leaching the phosphorite with hydrochloric acid contained 40.70 mg:U/l. An analytical method to control the uranium solubilization was outlined. A liquid-liquid extraction of uranium from these leaching solutions was performed using mixture of 3.3% di-(2-ethyl-hexyl)-phosphoric acid and 2.2% TBP in kerosene. After extraction the phosphoric acid free from uranium is sent to the calcium hydrogeno-phosphate production. The uranium is stripped from the organic phase by alkaline treatment and then precipitated as diuranate.

42727 **(INIS-BR—1009) Spectrophotometric determination of uranium and thorium with Arsenazo III in the flow injection system.** Andrade, M.dasG.M. de. (Pontificia Univ. Catolica do Rio de Janeiro (Brazil). Dept. de Quimica). Dec 1986. 166p. (In Portuguese). NTIS (US Sales Only), PC A08/MF A01. Order Number DE88702593/JAW.

A simple system for flow injection analysis (FIA) with double confluence was built using a filter photocolorimeter, an analogic potentiometer, 'plexiglass' flow cuvettes, polyethylene coils and tubes, 'plexiglass' commuter and peristaltic pump to introduce solutions and gravity as flow source. The system was dimensioned and studied using only Arsenazo III solutions. Spectrophotometric methods for uranium and thorium using Arsenazo III were studied using a scanning spectrophotometer and after chosing adequate red filter, adapted to photocolorimetry using flow cuvettes and FIA. Synthetic samples, phosphate rock, and process samples from uranium recovery of dolomites were analysed. Rocks of Morro do Ferro (MG, Brazil), Caldasite (Baddeleyte + Zirconite), Zirconite, Monazite from a program for certification and certified rocks (Dunite DC-1, CANMET) were analysed without chemical separation of Th (IV) and with ion exchange separation in semi-micro columns of cation exchange resin (Dowex 50).

42728 **Implications of mixed waste management for DOE facilities: FMPC, a case study.** Poff, T.A. *Transactions of the American Nuclear Society;* **52**: 22-24(1986). (CONF-860610—Summs.).

From American Nuclear Society annual meeting; Reno, NV, USA (15 Jun 1986).

Traditionally, US Dept. of Energy (DOE) facilities have conducted waste management operations in accordance with DOE operations orders and predecessor agency rules. These orders did not evolve in a parallel path as US Environmental Protection Agency (EPA) guidelines developed for the management of toxic and/or hazardous chemicals promulgated under RCRA and CERCLA. As a result of the Memorandum of Understanding between DOE and EPA reached following judicial mandates that DOE facilities must comply with RCRA and CERLA, DOE facilities have had to review carefully waste inventories and waste management practices. The Feed Materials Production Center (FMPC) has operated for more than 30 yr in its mission for DOE and its predecessor agencies. The mission has included several feedstock production tasks, including: (1) scrap copper recovery and production of copper ingots; and (2) conversions of enriched UF_6, depleted, UF_4, recycled UO_3, ore concentrates and residues into several feed products, including: depleted uranium punchings, thorium metal and oxides, depleted derby metal and ingots, depleted target element cores, and machined ingots, extrusions, and billets. In the production of these feed materials, a variety of radioactive and chemical wastes were generated. Most of the waste were stored in the Waste Storage Facilities (WSF), west of the plant site. The inventory of wastes currently qualifies the WSF as CERCLA sites. Those areas still in use, primarily Pit 4, qualify as RCRA sites.

0507 Fuels Production And Properties

REFER ALSO TO CITATION(S) 43495, 43618, 44223, 44257

42729 (INIS-mf—11044, pp 46-70) **Post-irradiation analysis of nuclear fuel elements.** Olguin Lojero, F. (Instituto Nacional de Investigaciones Nucleares, Mexico City). 1985. (In Spanish). NTIS (US Sales Only), PC A07/MF A01. Order Number DE88780072/JAW. (CONF-8508261—).

From Seminar of the Division of Materials and Testing; Salazar, Mexico (23 Aug 1985).

Several post-irradiation analytical determinations, among them metalography and isotopic abundance, are given for slightly enriched U_3SiAl mini-fuel plaques.

0508 Spent Fuels Reprocessing

REFER ALSO TO CITATION(S) 42865, 42870, 43082, 43571, 43572, 43580

42730 (CEA-CONF—9304) Control of neptunium in the PUREX process. Guillaume, B.; Wehrey, F.; Ayache, R. (CEA Centre d'Etudes Nucleaires de Fontenay-aux-Roses, 92 (France). Inst. de Recherche Technologique et de Developpement Industriel (IRDI)). 1987. 8p. (In French). (CONF-870801—). NTIS (US Sales Only), PC A02/MF A01. Order Number DE88753919/JAW.

From International conference on nuclear fuel reprocessing and waste management (RECOD '87); Paris, France (24 Aug 1987).

Neptunium chemistry in the mixture TBP 30 % in dodecane, less known than in aqueous solution, is presented especially cation-cation complexes, redox reactions and valence. Then behaviour in extraction cycles is examined. The choice of chemical reaction allows to direct neptunium either in fission products or for commercial use or with plutonium for use in fast neutron reactors. Nevertheless the choice is restricted by the priority given to uranium and plutonium purification which requires quantitative extraction, good U/Pu separation, good $\beta\gamma$ decontamination. 9 refs.

42731 (CONF-880752—4) Manual, voice, and automated control of a teleoperator viewing system. Draper, J.V.; Herndon, J.N. (Martin Marietta Energy Systems, Inc., Oak Ridge, TN (USA)). 1988. Contract AC05-84OR21400. 18p. NTIS, PC A 03; 3; GPO Dep. Order Number DE88011835/JAW.

From International symposium on teleoperation and control; Bristol, UK (12 Jul 1988).

During teleoperation, manipulator and television camera operation interfere with one another to the detriment of total teleoperator performance. This experiment investigated camera control options which may interfere less with manipulator than conventional manual controls. The experiment evaluated remote task performance with control by computer word recognition (voice input), automation of camera aiming, and manual control using push buttons and joy sticks. Operators worked more slowly with manual control and engaged in control motions for significantly smaller percentages of time than with voice input or automation. There was no difference between manual control and voice control in the number of camera changes made, but the automated tracking system made significantly more changes than the operators did. Camera movements lasted longest when operators used voice control, and changes made by the automated control system lasted longer than changes made with manual control.

42732 (PNL-TR—465) Investigations into the hydrazine-free electrochemical reduction of Pu(IV) in the PUREX Process. Heilgeist, M.; Flory, K.; Galla, U.; Schmieder, H. (Kernforschungszentrum Karlsruhe G.m.b.H. (Germany, F.R.)). Dec 1987. Contract AC06-76RL01830. Translation of KFK–4209. 93p. NTIS, PC A05/MF A01;1.

In the PUREX Process applied to spent fuel element reprocessing, the separation of uranium from plutonium is achieved by Pu(III) valence-setting. In order to protect Pu(III) against oxidation by nitrous acid {em dash} otherwise Pu(III) would oxidize to Pu (IV) in 1 M nitric acid {em dash} hydrazine is used as a nitrate capturin compound. Instead of using nitrous acid (or nitrogen oxides) as a reductant, the attempt was made to set the valence of Pu(III) electrochemically in the absence of hydrazine in a range of low acid concentration where nitrous acid has just lost its oxidizing properties. The following dependencies and influences were studied: nitric acid concentration/current density/temperature/uranium content/electrode surface ratio/influence of extremely low hydrazine concentrations. The re-oxidation behavior was also studied of the completely reduced Pu(III)-containing solutions. Results of experiments run in pure aqueous systems were applied in a pulse column with the TBP/dodecane/HNO_3 system. Conclusions drawn from experiments, that electrochemical U/Pu-separation is in principle possible without adding hydrazine, were confirmed by the pulse column experiments. 33 refs., 34 figs., 20 tabs.

42733 Temperature dependency of $UO_2$2i fluorescence in nitric acid solutions. Fujimori, H.; Matsui, T.; Suzuki, K.; Hayashi, S.; Wada, Y. *Transactions of the American Nuclear Society;* **52**: 42-43(1986). (CONF-860610—Summs.).

From American Nuclear Society annual meeting; Reno, NV, USA (15 Jun 1986).

Fluorimetry can possibly be used in the process of in-line uranium concentration monitoring in raffinate during the codecontamination process in nuclear fuel reprocessing plants, since it has an intrinsic high sensitivity and a capability for remote monitoring using fiber optics. Before its practical application, factors influencing UO_2^{2+} fluorescence, such as temperature, coexisting species, etc., must be examined. In this paper, the effect of temperature on UO_2^{2+} fluorescence was studied in a system without coexisting species.

42734 Records plan for PUREX process safety boundaries/conditions. Bendixsen, R.B. *Transactions of the American Nuclear Society;* **52**: 43-44(1986). (CONF-860610—Summs.).

From American Nuclear Society annual meeting; Reno, NV, USA (15 Jun 1986).

The safety of nuclear facilities requirements specified by the US Dept. of Energy (DOE) contain a statement that a formal documentation system for the control and traceability of records and documentation... is a basic requirement. The PUREX plant location near Richland, Washington, was restarted in November 1983 to produce weapons-grade plutonium oxide for the US Dept. of Defense. The plant had been maintained in a standby condition since it was shutdown in 1972. A formalized records plan was needed to comply with DOE requirements and a project to identify the records was initiated.

42735 SGMP process for high-density UO_2- and ThO_2-based fuels. Ganguly, C.; Zimmer, E.; Merz, E. *Transactions of the American Nuclear Society;* **52**: 44-46(1986). (CONF-860610—Summs.).

From American Nuclear Society annual meeting; Reno, NV, USA (15 Jun 1986).

The sol-gel microsphere pelletization (SGMP) process is a recent concept of oxide fuel pellet fabrication using sol-gel-derived microspheres for pellet pressing and sintering. The SGMP process is particularly attractive for remote refabrication of highly radiotoxic ^{233}U- and plutonium-bearing oxide fuel pellets because of the dust-free and free-flowing nature of microspheres. However, the process has not been proven to be successful thus far. In the present study, the external gelation of thorium (EGT) and external gelation of uranium (EGU) processes of Kernforschungsanlage have been modified to produce microspheres suitable for making pellets of high density (≧ 95% TD) and desirable microstructure using pressing and sintering parameters similar to those used in the conventional powder route. The pellet compositions chosen are ThO_2-2% UO_2, ThO_2-5% CeO_2, UO_2-5% CeO_2, and UO_2-30% CeO_2. Cerium has been used for the simulation of plutonium.

42736 Horizontal spent fuel consolidation equipment. Blissell, W.H. *Transactions of the American Nuclear Society;* **52**: 58-59(1986). (CONF-860610—Summs.).

From American Nuclear Society annual meeting; Reno, NV, USA (15 Jun 1986).

Consolidation of spent nuclear fuel involves dismantling the fuel assembly, extracting the fuel rods, and reordering the rod arrangement from that of an open, square array to a close-packed, triangular array. Although no production consolidation equipment currently exists, many types have been proposed, ranging from single rod extraction to multiassembly types. A single assembly (element), multiple fuel rod extraction and reordering device, referred to as a single element consolidation system (SECS) is included in this paper.

42737 **Spent fuel consolidation demonstration at Battelle Columbus.** Wachter, W.J. *Transactions of the American Nuclear Society;* **52**: 59-60(1986). (CONF-860610—Summs.).

From American Nuclear Society annual meeting; Reno, NV, USA (15 Jun 1986).

The US Tool & Die consolidation system is now a completely closed system capable of consolidating fuel at rates of two to six assemblies per shift in the spent fuel pool. The heart of the system is the funnel that guides each rod through a closed path free of impact loads and transforms the open, square array of fuel rods into a tight triangular pack. The latest development tested at the pool in live spent fuel was the automatic feeder system that draws rods from the fuel assembly and feeds them into the canister.

42738 **Systems study of the back end of the nuclear fuel cycle.** Saling, J.H. *Transactions of the American Nuclear Society;* **52**: 70-72(1986). (CONF-860610—Summs.).

From American Nuclear Society annual meeting; Reno, NV, USA (15 Jun 1986).

This study utilized a unique approach in applying conventional systems engineering in the selection of the optimum metal cask system to provide packaging, handling, storage, transportation, and disposal of spent fuel. This systems evaluation combined traditional systems engineering analysis and multiattribute decision analysis. This envisioned the involvement and participation of a peer advisory group consisting of representatives of public, governmental, and technical interests. The traditional systems engineering analysis included an economic assessment to determine overall system costs and a technical assessment of each system with respect to the system-wide functional requirements and criteria developed during this study. The results of this traditional systems engineering analysis were combined with other analyses in a multiattribute decision analysis using a set of value criteria derived from input from the peer advisory group. Through this method, the interests and concerns of all parties could be addressed as an integral part of the development of a spent fuel management system. The value criterion was generated in an attempt to satisfy all those either involved with, affected by, or concerned with the spent fuel management system and addressed the numerous technical and institutional factors involving health, safety, licensing, and economic issues.

42739 **Training West Valley operators to stabilize high-level waste.** Salisbury, M.F.; Harward, D.J.; Gessner, R.F. *Transactions of the American Nuclear Society;* **52**: 82(1986). (CONF-860610—Summs.).

From American Nuclear Society annual meeting; Reno, NV, USA (15 Jun 1986).

The West Valley Demonstration Project (WVDP) was formed to solidify 2271-m^3 (560,000 gal) of high-level waste (HLW) generated during commercial fuel reprocessing operations in the 1960s and early 1970s. The process selected involves vitrifying the waste with glass formers to produce borosilicate glass encapsulated in steel canisters 61 cm in diameter by 305 cm (2 ft in diameter by 10 ft long). The canisters will ultimately be sent to a federal HLW repository for disposal. The vitrification system is being installed and simultaneously undergoing extensive testing at West Valley using nonradioactive materials simulating the waste composition. Operating personnel are being trained to operate the glass melter concurrent with the installation and test program. Some operators have experience in chemical plants while others are inexperienced. The challenge accepted at West Valley is to provide a full scope of training and qualification to ensure that they can perform their duties safely, efficiently, and correctly to produce the required quality glass and to assure that when we initiate HLW processing in 1988 both operators and equipment will be ready.

0509 Transport And Storage

REFER ALSO TO CITATION(S) 42738, 42801, 43630

42740 (CONF-871075—Vol.1-Pt.3, pp 27-32) **Tracking and monitoring transuranic waste shipments for the Waste Isolation Pilot Plant.** Lattin, W.C. (Westinghouse Electric Corp.). 1987. NTIS, PC A18/MF A01. Order Number DE88007805/JAW.

From 3. Oak Ridge model conference on waste problems; Oak Ridge, TN, USA (13 Oct 1987).

Beginning in October, 1988, the Department of Energy (DOE) will begin shipping contact-handled transuranic (CH-TRU) waste from the various DOE-owned facilities to the Waste Isolation Pilot Plant (WIPP) near Carlsbad, New Mexico. Shipment of the waste will be made in specially-designed containers, called TRUPACTs, and vehicle movement and status will be monitored by the Department of Energy's Transcom satellite system. That signal will be available for use by the States along the shipping routes, as well as provide a feed to the Central Coordination Center (CCC) in Carlsbad, NM. The Center will employ its own computer software (Phoenix) to refine the Transcom signal to more accurately locate, monitor, and communicate with these vehicles to ensure safe and efficient movement of wastes.

42741 **(DOE-CH/TPO—001) Analysis of radiation doses from operation of postulated commercial spent fuel transportation systems: Main report.** Schneider, K.J.; Hostick, C.J.; Ross, W.A.; Peterson, R.W.; Smith, R.I.; Stiles, D.L.; Daling, P.M.; Weakley, S.A.; Grinde, R.B.; Young, J.R. (USDOE Chicago Operations Office, Argonne, IL; Pacific Northwest Lab., Richland, WA (USA)). Nov 1987. Contract AC06-76RL01830. 313p. NTIS, PC 13. Order Number TI88008643/JAW.

Includes 6 sheets of 24x reduction microfiche.

This report contains a system study of estimated radiation doses to the public and workers resulting from the transport of spent fuel from commercial nuclear power reactors to a geologic repository. The report contains a detailed breakdown of activities and a description of time/distance/dose-rate estimates for each activity within the system. Collective doses are estimated for each of the major activities at the reactor site, in transit, and at the repository receiving facility. Annual individual doses to the maximally exposed individuals or groups of individuals are also estimated. A total of 17 alternatives and subalternatives to the postulated reference transportation system are identified, conceptualized, and their dose-reduction potentials and costs estimated. Resulting ratios of Δcost/Δcollective system dose for each alternative relative to the postulated reference transportation system are given. Most of the alternatives evaluated are estimated to provide both cost and dose reductions. Major reductions in transportation system dose and cost are estimated to result from using higher-capacity rail and truck casks, and particularly when replacing legalweight truck casks with "advanced design" overweight truck casks. The greatest annual dose reduction to the highest exposed individual workers (i.e., at the repository) is estimated to be achieved by using remote handling equipment for the cask handling operations at the repository. Additional shielding is also effective in reducing doses to both radiation workers at the reactor and repository and to transport workers. 69 refs., 36 figs., 156 tabs.

42742 (IAEA-SR—110(bk.), pp 106-117) **Packaging, transportation and interim storage of unconditioned and conditioned wastes.** Baehr, W.W. (International Atomic Energy Agency, Vienna (Austria)). 1986. NTIS (US Sales Only), PC A99/MF A01. Order Number DE88702505/JAW. (CONF-861065—).

From Seminar on management options for low and intermediate level wastes in Latin America; Rio de Janeiro, Brazil (13 Oct 1986).

The methods and experiences for packaging, transport and possibilities for interim storage of unconditioned wastes are described. After the waste treatment and immobilization, it is packaged for transport and final disposal following the requirements of the IAEA transport regulations and national regulations. The characteristics of some common types of containe and shielding systems, and some techniques for interim storage of conditioned wastes, are presented.

42743 (IAEA-SR—110(bk.), pp 118-126) **Concrete conditioners for low-intermediate level nuclear wastes.** Roehl, J.L.; Lorentz, R.G.; Franzen, H.R. (Pontificia Univ. Catolica do Rio de Janeiro (Brazil); Comissao Nacional de Energia Nuclear de Brasil, Rio de Janeiro). 1986. NTIS (US Sales Only), PC A99/MF A01. Order Number DE88702505/JAW. (CONF-861065—).

From Seminar on management options for low and intermediate level wastes in Latin America; Rio de Janeiro, Brazil (13 Oct 1986).

The conditioning of low-intermediate level radioactive waste disposal, in Brazil, with concrete packages designed in such way that, in spite of being destined to receive compacted materials in long term sub-surface disposal, they may also be able to attend other storage or disposal necessities, is analysed. A design of a reinforced concrete package with a net volume of 360 l and, with compatible diameter to contain compacted 200 l drums, was developed. A study on compactation of 200 l steel packages is done. A pressure of 30.000 KN for compacting these 200 l drums was adapted, and two series of tests to verify the pressure volume reduction ratio and, the final dimensions and density of the compacted elements, was executed.

42744 **(INIS-mf—11178) Risk assessment of subsidiary nuclear technologies.** Kalchev, B.; Ilieva, S.; Jordanova, P.; Andreev, P. (Energoproekt, Sofia (Bulgaria)). 1984. 10p. (In Bulgarian). (CONF-8405447—). NTIS (US Sales Only), PC A02/MF A01. Order Number DE88702604/JAW.

From 6. national conference on thermal and nuclear power problems in Bulgaria; Varna, Bulgaria (17 May 1984).

The results from a risk assessment for processing, transportation and storage of radioactive wastes and for spent fuel storage and transportation are presented. Use of bituments for waste processing is assumed. A comparative risk analysis for nuclear reactor operation and subsidiary technologies is given.

42745 **Rush to invent versus the need to succeed.** Rhodes, S.H.; Stucker, J.J. *Transactions of the American Nuclear Society;* **52**: 64-65(1986). (CONF-860610—Summs.).

From American Nuclear Society annual meeting; Reno, NV, USA (15 Jun 1986).

Integral to the Nuclear Waste Policy Act (NWPA) of 1982, which provides for the development of geologic repositories for the permanent disposal of high-level nuclear waste, is a consultation process designed to assure that decisions are made publicly. As a portion of the US Dept. of Energy (DOE) responsibility to establish repositories, the NWPA requires DOE to complete a detailed study of the need for an feasibility of monitored retrievable storage (MRS) in the form of a proposal to Congress. Based on this proposal, Congress may or may not authorize construction of this temporary facility. The MRS proposal presented by DOE to Congress this session has important failings. Various obscure judgments are the foundation of the MRS proposal. The proposal fails to consider the question of spent fuel handling alternatives prior to disposal, the need for spent fuel storage at an MRS is not established, and many cheaper storage options appear to be foreclosed by the establishment of the proposed MRS. The centerpiece of the proposal is the development and demonstration of a centralized dry rod consolidation facility, although the at-repository advantages of rod consolidation are not clear. The DOE decision to develop an inventive MRS program as an integral part of the repository program is inconsistent with the NWPA and appears to present serious and unnecessary risks to the successful implementation of the program. A review of demonstrated and affordable alternatives to MRS is presented here.

42746 **Overview of the DOE PRDA program and its impact on the waste management program.** Conner, C.W. *Transactions of the American Nuclear Society;* **52**: 67-68(1986). (CONF-860610—Summs.).

From American Nuclear Society annual meeting; Reno, NV, USA (15 Jun 1986).

With the passage of the Nuclear Waste Policy Act (NWPA), a clear policy was established for the management of spent fuel and high-level wastes in the United States. The challenge for the government is to design and implement a waste management system that is safe, efficient, cost-effective, and can be implemented in a timely manner. The possible functions, facilities, and considerations that must be addressed in designing the waste management system are illustrated. Soon after the NWPA was promulgated, the US Dept. of Energy (DOE) turned to the nuclear industry for ideas, and in March 1984, a competitive solicitation called a Program Research and Development Announcement (PRDA) was issued. The objective of this PRDA was to invite industry to identify and develop technical and institutional alternatives for near-term and long-term handling, packaging, shipping, and storing of spent fuel in ways that could facilitate and/or minimize handling and packaging for final disposal. The DOE encouraged a systems approach, i.e., the study of the waste packaging and handling system as an integrated whole. Five contracts were awarded to study a variety of ideas. The PRDA program provided supporting data allowing the screening of the potentially beneficial concepts proposed by industry and the selection of those concepts that ought to be pursued further in the near future.

42747 **Impact of using half-square cans on the integrated waste system.** Eckert, H.J.; Park, Y.M.; Heath, C.A. *Transactions of the American Nuclear Society;* **52**: 68-70(1986). (CONF-860610—Summs.).

From American Nuclear Society annual meeting; Reno, NV, USA (15 Jun 1986).

NUS Corporation was one of six contractors selected under the Program Research and Development Announcement (PRDA) for a nuclear waste packaging and handling design initiative issued by the US Dept. of Energy (DOE). The purpose of this paper is to present the results of the NUS study pertaining to a specific innovation in spent nuclear fuel management - the concept of half-square cans. This particular innovation, when used in appropriate arrays of mixed half- and full-square cans, is compatible with the existing square-geometry storage systems at reactors and has the advantage of reducing disposal system costs through improved utilization of cylindrical-geometry shipping casks and waste disposal packages. The advantages of the half-square can concept are fully realized in conjunction with fuel element disassembly and consolidation. Fuel consolidation approximately doubles the fuel loading of containers and thereby reduces several types of costs. This study shows that disposal system costs tend to be minimized when fuel is transported, stored, and disposed of in consolidated form.

42748 **Study of extra-large storage casks.** McCreery, P.N. *Transactions of the American Nuclear Society;* **52**: 72-73(1986). (CONF-860610—Summs.).

From American Nuclear Society annual meeting; Reno, NV, USA (15 Jun 1986).

Transnuclear, Inc.'s long involvement in spent fuel cask development and design has been characterized by an effort to maximize capacities within the constraints of typical design criteria. In this study, the author have circumvented the conventional restraint of limiting the cask loaded weight t the lifting limits of the reactor cranes by using other fuel loading techniques. It is then endeavored to determine the limiting criteria wherein weight is not a factor. The study included, of course, the operational techniques to make the large casks operable and functional. The scope of the study included for basic variations of the extra-large storage cask (XLSC); namely, storage/transport for intact fuel, storage transport for consolidated fuel, storage-only for intact fuel, and storage-only for consolidated fuel. Studies included both boiling water reactor (BWR) and pressurized water reactor (PWR) assemblies for each of the four cases.

42749 **Centralized disassembly and packaging of spent fuel in the DOE spent fuel management system.** Johnson, E.R. *Transactions of the American Nuclear Society;* **52**: 73-74(1986). (CONF-860610—Summs.).

From American Nuclear Society annual meeting; Reno, NV, USA (15 Jun 1986).

In October 1984, E.R. Johnson Associates, Inc. (JAI) initiated a study of the prospective use of a centralized facility for the disassembly and packaging of spent fuel to support the various elements of the US Dept. of Energy (DOE) spent fuel management system, including facilities for monitored retrievable storage (MRS) and repositories. It was DOE's original plan to receive spent fuel at each repository where it would be disassembled and packaged

(overpacked) for disposal purposes. Subsequently, DOE considered the prospective use of MRS of spent fuel as an option for providing safe and reliable management of spent fuel. This study was designed to consider possible advantages of the use of centralized facilities for disassembly and packaging of spent fuel at whose location storage facilities could be added as required. The study was divided into three principal technical tasks that covered: (a) development of requirements and criteria for the central disassembly and packaging facility and associated systems. (2) Development of conceptual designs for the central disassembly and packaging facility and associated systems. (3) Estimation of capital and operating costs involved for all system facilities and determination of life cycle costs for various scenarios of operation - for comparison with the reference system.

42750 MINIMAX system concept for managing spent nuclear fuel. Best, R.E.; Pobereskin, M. *Transactions of the American Nuclear Society;* **52**: 74-75(1986). (CONF-860610—Summs.).

From American Nuclear Society annual meeting; Reno, NV, USA (15 Jun 1986).

In FY 1985, the US Dept. of Energy (DOE's) Office of Civilian Radioactive Waste Management (OCRWM) contracted with six project teams under the auspices of a Program Research and Development Announcement to evaluate alternatives for handling, transporting, storing, and disposing of spent nuclear fuel discharged from commercial nuclear power reactors. The authors participated in the study of the merits of the MINIMAX concept, which was one of the six concepts the OCRWM selected for evaluation. This paper presents the MINIMAX concept and discusses the results of preliminary evaluations that were completed. The MINIMAX system for managing the back end of the fuel cycle derives its name from the dual design goals of (a) having minimum impact on existing components of the fuel cycle, particularly the nuclear power reactors, while (b) preserving maximum flexibility, both programmatic and technical, in development of the future components. Thus, considering the long time span inherent in closing the fuel cycle, no early decisions are likely to impose constraints on future developments and create difficult backfitting problems.

0520 Waste Management

REFER ALSO TO CITATION(S) 42728, 42739, 42740, 42742, 42743, 42744, 42744, 42864, 43062, 43176, 43528, 43861, 43914, 43922, 44299

42751 (AERE-R—12344) Simple test cases for flow and transport in the undersaturated zone. Jackson, C.P.; Williams, M.G. (UKAEA Harwell Lab. Theoretical Physics Div.; Department of the Environment, London (UK)). Feb 1988. 17p. (DOE-RW—87.068). H.M. Stationery Office, London, price Pound 4.00.

We provide analytical solutions of certain simple test problems for flow and transport in an undersaturated zone. These test problems are special examples of one-dimensional vertical infiltration. The NAMMU code has been verified by means of these examples; its results were in good agreement with the analytical solutions.

42752 (ANL—88-14) The reaction of glass during gamma irradiation in a saturated tuff environment: Part 3, long-term experiments at 1 x 10^4 rad/hour. Abrajano, T.A. Jr.; Bates, J.K.; Gerding, T.J.; Ebert, W.L. (Argonne National Lab., IL (USA)). Feb 1988. Contract W-31109-ENG-38. 118p. NTIS, PC A06/MF A01;1; GPO Dep. Order Number DE88012171/JAW.

Savannah River Laboratory 165 type glass was leached with equilibrated J-13 groundwater at 90{degree}C for times up to 182 days. These experiments were performed as part of an effort by the Nevada Nuclear Waste Storage Investigations Project to assess the importance of radiation effects on repository performance and waste glass corrosion. The gamma radiation field used in this work was 1. 0 +- 0.2 x 10^4 rad/h. Glass dissolution is notably incongruent throughout the entire experimental periods and normalized releases follow the sequence Li ≧ Na ≧ B ≃ U ≧ Si. The normalized leach rates of these elements, as well as the measured growth rates of the reaction layers, decreased with time. The only significant variation observed in the abundance of anions is the systematic decrease in NO_3/sup {minus}//NO_3/sup {minus}/ ratio from the starting EJ-13 groundwater to the EJ-13 blank experiments to the tuff- and glass-containing experiments. A leaching model that is consistent with the observed solution data and depth profiles is presented. The applicability and limitation of the present results in predicting the actual interactions that may occur in the NNWSI repository are discussed. 35 refs., 30 figs., 12 tabs.

42753 (BMI/ONWI/C—7) Salt Repository Project site study plan for background environmental radioactivity: Revision 1. (Battelle Memorial Inst., Columbus, OH (USA). Office of Nuclear Waste Isolation; Stone and Webster Engineering Corp., Boston, MA (USA)). Dec 1987. Contract AC02-87CH10290;AC02-87CH10285. 81p. H. Order Number TI88012361/JAW.

The Site Study Plan for Background Environmental Radioactivity describes a field program consisting of an initial radiological survey and a radiological sampling program. The field program includes measurement of direct radiation and collection and analysis of background radioactivity samples of air, precipitation, soil, water, milk, pasture grass, food crops, meat, poultry, game, and eggs. The plan describes for each study the need for the study, the study design, data management, and use, schedule of proposed activities, and quality assurance requirements. These studies will provide data needed to satisfy requirements contained in, or derived from, the Salt Repository Project Requirements Document. 43 refs., 10 figs., 7 tabs.

42754 (BMI/ONWI/C—10) Carbon-14 in the Palo Duro basin repository. Choppin, G.R. (Battelle Memorial Inst., Columbus, OH (USA). Office of Nuclear Waste Isolation; Florida State Univ., Tallahassee (USA). Dept. of Chemistry). 1987. Contract AC02-87CH10290. 9p. H. Order Number TI88012362/JAW.

Operation of nuclear reactors results in production of the radioactive nuclide carbon-14. In a typical light water pressurized reactor using oxide fuel, the rate of C-14 formation is 10 to 20 Ci per GWe-year. Thermal neutrons can form C-14. However, the lower isotopic concentration (1.1%) combined with the low reaction cross section (less than one millibarn) makes this a minor pathway for C-14 production. Fast neutrons can form C-14 from the oxygen present by the reaction $^{16}O(n, {}^3He)\ ^{14}C$ but the cross section for this reaction is smaller than for the $^{14}N(n, p)\ ^{14}C$ reaction. This latter is the major mode of C-14 formation and occurs because of the small amount, typically 10 to 60 ppM, of nitrogen dissolved in the nuclear fuel. Reprocessing of the spent fuel eliminates the C-14 as CO_2 off-gas in the dissolving step. However, in the once-through mode, the carbon would be retained in the encapsulated fuel placed in the geologic repository. This report addresses the possible species and behavior of the C-14 which might be released in time from the waste package. 8 refs.

42755 (BMI/ONWI/C—16) Faulting in the northern Palo Duro Basin, Texas: Revision 1, Topical report. Regan, T.R.; Murphy, P.J. (Battelle Memorial Inst., Columbus, OH (USA). Office of Nuclear Waste Isolation; Stone and Webster Engineering Corp., Boston, MA (USA)). Aug 1986. Contract AC02-87CH10290;AC02-83CH10140;AC02-87CH10285. 92p. (BMI/ONWI—677; ONWI/Sub—86/E512-05000-T30). H. Order Number TI88012351/JAW.

Location, vertical displacement, and latest detectable movement have been determined for 90 faults identified in the northern Palo Duro Basin of Texas. The interpretations are based on lithostratigraphic correlations, using geophysical logs and sample logs from 905 wells across 12 counties, and seismic surveys conducted in portions of six counties. The stratigraphic interval studied extends from crystalline basement (Precambrian) to the Alibates Formation (Upper Permian). Most of the faults strike northwest, have near vertical dips, and are associated with the Amarillo Uplift, Oldham Nose, and/or the saddle separating them. Horizontal displacements were not determined. The maximum vertical displacement observed is nearly 6300 ft (1920 m), with maximum offsets on individual faults commonly in the 1000-to 3000-ft (300-to 910-m) range. About half of the faults extend onto the Lower Permian section, and at

least 12 of those offset the Alibates Formation. 62 refs., 27 figs., 2 tabs.

42756 **(BMI/ONWI/C—21) Measurements of the solubility of selected solids containing lead, tin, strontium or selenium: Test plan.** Brubaker, K.L. (Battelle Memorial Inst., Columbus, OH (USA). Office of Nuclear Waste Isolation; Argonne National Lab., IL (USA)). 26 Jun 1987. Contract AC02-87CH10290. 18p. H. Order Number TI88012359/JAW.

This report presents a test plan for the experimental determination of the solubilities of several solid compounds of lead, tin, strontium, and selenium that were identified in the literature review as having the potential to limit the concentration of these elements in brines. The objectives of this study are to obtain accurate experimental solubilities of potentially critical compounds of the four elements given above under a wide variety of anticipated repository conditions; to determine the need for a new evaluation of the values of various parameters, such as stability constants and activity coefficients, that are required for an accurate description of the aqueous state of these elements under the anticipated conditions; and to provide a series of measurements with which to compare theoretical predictions for model validation purposes. The indicated priorities are based primarily on the relative expected solubilities of the substances involved and secondarily on the nature of the available information. The literature survey document should be consulted for a detailed discussion of the methodology that led to the selection of these substances. 9 refs., 10 tabs.

42757 **(BMI/ONWI/C—33) Salt Repository emplacement mode evaluation and selection: Final report.** (Battelle Memorial Inst., Columbus, OH (USA). Office of Nuclear Waste Isolation; Fluor Engineers, Inc., Irvine, CA (USA). Advanced Technology Div.). Mar 1988. Contract AC02-87CH10290;AC02-83WM46656. 591p. H. Order Number DE88013258/JAW.

This document describes the decision analysis performed to evaluate and compare the emplacement mode for the Salt Repository. The study was commissioned to recommend one emplacement mode to the Salt Repository Project Office using multi-attribute decision analysis. The nature of the decision required analysis of uncertain outcomes and conflicting attributes and offers a high degree of objectivity for these types of decisions since the decision model is structured to allow only the facts to enter into the final decision. The analysis requires an explicit definition of the attributes used to evaluate the alternative (e.g., cost, safety, environmental impact), the definition of a utility function over the attributes which incorporated both risk attitudes and trade-offs between attributes, and the probability distribution over the outcomes that would result from the selection of one alternative over the other. The decision process is described and results are given. A simulation model was developed to evaluate the probability distributions over the attributes. This report documents logic, inputs and results of this model. Final ranking of alternatives is given. Extensive technical backup documentation is included in the appendices to provide the quantitative basis for this decision. 5 refs., 2 figs., 8 tabs.

42758 **(BMI/ONWI/C—36) Simulation of the Sandia Laboratory Salt Block II, brine migration experiment.** Ratigan, J.L.; Brandshaug, T. (Battelle Memorial Inst., Hereford, TX (USA). Office of Nuclear Waste Isolation; RE/SPEC, Inc., Albuquerque, NM (USA)). Mar 1988. Contract AC02-87CH10290;AC02-83CH10140. 71p. (BMI/ONWI—628). OSTI, PO Bx 62, Oak Ridge, TN 3783104. Order Number TI88013311/JAW.

The finite-element code SPECTROM-58 is used to simulate the Salt Block II brine migration experiment. All input quantities for the computer code are treated as stochastic quantities. The measured results of the Salt Block II experiment are within the range of the SPECTROM-58 computed results. However, the range of calculated results that arises from the uncertainty in the input quantities is so large that an evaluation of the aptness of SPECTROM-58 is precluded. The current uncertainty in several of the input parameters must be reduced through laboratory testing before the Salt Block II experiment can be used for validating SPECTROM-58. 29 refs., 22 figs., 11 tabs.

42759 **(BMI/ONWI/C—61) Analysis of pumping test data: Sawyer No. 1, Mansfield No. 1, Zeeck No. 1, and J. Friemel No. 1 wells: Topical report.** Wilton, D.E.; Picking, L.W.; Deltufo, A.M.; Fontaine, R.C. (Battelle Memorial Inst., Columbus, OH (USA). Office of Nuclear Waste Isolation; Stone and Webster Engineering Corp., Boston, MA (USA)). Aug 1986. Contract AC02-87CH10290;AC02-87CH10285;AC02-83CH10140. 278p. (ONWI/SUB—86/05000-T55). H. Order Number DE88012839/JAW.

From June 1981 through August 1984, four deep hydrogeologic test wells were drilled in the Palo Duro Basin of Texas. The wells were part of an area characterization program to evaluate the basin for suitable high-level radioactive waste repository sites. Pumping test data from four wells, Sawyer No. 1, Mansfield No. 1, Zeeck No. 1, J. Friemel No. 1, have been analyzed using numerical simulation and type-curve comparison techniques. The testing procedure consisted of several pumping cycles. Each cycle consisted of a period of constant-rate pumping followed by a period of recovery. A method was developed to include the effects of prior cyclic pumping/recovery history while recovery for each cycle was plotted. From the recovery curves, preliminary values of transmissivity and initial formation pressure were estimated, and aquifer boundary configurations were assessed. This preliminary information was used as initial input to a finite-element model of the test zone, and parameters were refined through trial and error until an acceptable match between modeled and actual curves was obtained. 15 refs., 138 figs., 40 tabs.

42760 **(BMI/ONWI/C—86) Technical procedures for ecology: Environmental field program, Deaf Smith County Site, Texas: Final draft.** (Battelle Memorial Inst., Columbus, OH (USA). Office of Nuclear Waste Isolation; Morrison-Knudsen Engineers, Inc., Denver, CO (USA)). Aug 1987. Contract AC02-87CH10290;AC02-83CH10140. 331p. H. Order Number TI88012842/JAW.

This volume contains Technical Procedures pursuant to the Land Use Site Study Plan including walkover surveys for threatened, endangered, or candidate species; vegetation classification and mapping; reclamation planning; wetland and floodplain determination and characterization of playas; wildlife habitat mapping methods; mammal sampling; bird survey methods; reptile and amphibian survey methods; preexisting environmental; stress and disturbance studies methods; voucher specimens for plants; and voucher specimens to wildlife. 9 refs., 5 figs., 1 tab.

42761 **(BMI/ONWI/C—105) Palo Duro seismographic network operation report for July to December 1986: Topical report No. 6.** Acharya, H.; Tyrala, L. (Battelle Memorial Inst., Columbus, OH (USA). Office of Nuclear Waste Isolation; Stone and Webster Engineering Corp., Boston, MA (USA)). Jun 1987. Contract AC05-84OR21400;AC02-83CH10140;AC02-87CH10290. 149p. (ONWI/Sub—87/E512-05000-T59). H. Order Number DE88012380/JAW.

A seismographic network operates in the Texas Panhandle to monitor earthquake activity in the area. This report describes the network and its operation, as well as analysis of data obtained during the period of July 1 to December 31, 1986. The network continued to operate satisfactorily during this period. Several local and regional earthquakes were detected and located during this period. These earthquakes occurred in the northern half of the Texas Panhandle and were small (magnitude $\leq$3.0). None of the earthquakes was felt. Mansfield Station continued to detect a number of very small earthquakes occurring near the station, but it was not possible to locate them since no other station detected them. All elements of the seismographic network were tested and checked in September 1986 and January 1987, as part of the Stone & Webster Engineering Corporation (SWEC) quarterly maintenance program. Monitoring at Buffalo Lake Wildlife Refuge and Muleshoe Wildlife Refuge Stations was terminated on July 15 and November 1, 1986, respectively, because the permits for operating these stations were not renewed. The seismographic network now consists of 14 seismic stations, 4 relay stations, and 1 Central Recording Station. 4 refs., 8 figs., 9 tabs.

42762 **(BMI/ONWI/C—107) Glossary of terms used in the disposal of high-level wastes: Salt Repository Project.** (Battelle Memorial Inst., Columbus, OH (USA). Office of Nuclear Waste Isolation). Feb 1987. Contract AC02-87CH10290. 164p. H. Order Number TI88012829/JAW.

This glossary provides definitions of words and phrases specific to, or used in a special way in, documents of the US Department of Energy's Civilian Radioactive Waste Management Program. In many cases, two or more definitions of a word or phrase are given. Sources are provided for all definitions. 33 refs.

42763 **(BMI/ONWI/C—116) Sensitivity and uncertainty analysis of linear cost codes: Draft final report.** Thomas, R.E.; Pelfrey, S.T.; Milton, J.B. (Battelle Columbus Div., OH (USA)). Sep 1986. Contract AC02-87CH10290. 43p. H. Order Number TI88012831/JAW.

This report summarizes the results obtained in applying the method of cumulants to a portion of the REFSALT computer code. The report consists of three parts: (1) survey the literature and compare the cumulant method with other uncertainty/sensitivity methods; (2) outline ways to quantify expert opinion for use in generating uncertainty estimates; and (3) apply the cumulant method to the REFSALT computer code using a few selected variables. These three parts are followed by two appendices: Appendix A contains an outline of the sensitivity/uncertainty procedure and Appendix B contains a User's Guide for REFSALT. 14 refs., 6 figs., 2 tabs.

42764 (CONF-871075—Vol.1-Pt.3, pp 3-12) **Overview of DOE's Transuranic Waste Program.** McFadden, M.H.; Detamore, J.A. (Dept. of Energy, Washington, DC (USA)). 1987. NTIS, PC A18/MF A01. Order Number DE88007805/JAW.

From 3. Oak Ridge model conference on waste problems; Oak Ridge, TN, USA (13 Oct 1987).

The US Department of Energy has assigned to Albuquerque Operations the Defense Transuranic Waste Program responsibility for long-range planning and management of defense transuranic (TRU) waste. The Transuranic Waste Lead Organization (TLO) has divided the Program into seven elements which support it's primary goal of ending interim storage and achieving permanent disposal. These are: waste generation site activities, storage site activities, burial site activities, technology development, transportation, institutional activities, and permanent disposal. This paper will briefly discuss these seven elements and how they are integrated to provide for successful achievement of the primary goal.

42765 (CONF-871075—Vol.1-Pt.3, pp 13-25) **DOE's plan for buried transuranic (TRU) contaminated waste.** Mathur, J.; D'Ambrosia, J.; Sease, J. (Dept. of Energy, Germantown, MD (USA)). 1987. NTIS, PC A18/MF A01. Order Number DE88007805/JAW.

From 3. Oak Ridge model conference on waste problems; Oak Ridge, TN, USA (13 Oct 1987).

Prior to 1970, TRU-contaminated waste was buried as low-level radioactive waste. In the Defense Waste Management Plan issued in 1983, the plan for this buried TRU-contaminated waste was to monitor the buried waste, take remedial actions, and to periodically evaluate the safety of the waste. In March 1986, the General Accounting Office (GAO) recommended that the Department of Energy (DOE) provide specific plans and cost estimates related to buried TRU-contaminated waste. This plan is in direct response to the GAO request. Buried TRU-contaminated waste and TRU-contaminated soil are located in numerous inactive disposal units at five DOE sites. The total volume of this material is estimated to be about 300,000 to 500,000 m^3. The DOE plan for TRU-contaminated buried waste and TRU-contaminated soil is to characterize the disposal units; assess the potential impacts from the waste on workers, the surrounding population, and the environment; evaluate the need for remedial actions; assess the remedial action alternatives; and implement and verify the remedial actions as appropriate. Cost estimates for remedial actions for the buried TRU-contaminated waste are highly uncertain, but they range from several hundred million to the order of $10 billion.

42766 (CONF-871075—Vol.1-Pt.3, pp 33) **Feasibility study for an RH-TRU Waste Sludge Facility at ORNL.** Saleh, F.M. (Southern Univ., Baton Rouge, LA (USA)). 1987. NTIS, PC A18/MF A01. Order Number DE88007805/JAW.

From 3. Oak Ridge model conference on waste problems; Oak Ridge, TN, USA (13 Oct 1987).

42767 (CONF-871075—Vol.1-Pt.3, pp 235-249) **ORO scrap metal decontamination program.** Jugan, M. 1987. NTIS, PC A18/MF A01. Order Number DE88007805/JAW.

From 3. Oak Ridge model conference on waste problems; Oak Ridge, TN, USA (13 Oct 1987).

The Oak Ridge Operations Office (ORO) of the US Department of Energy (DOE) has approximately 80,000 tons of contaminated scrap metal at the Oak Ridge Gaseous Diffusion Plant in Oak Ridge, Tennessee; Paducah Gaseous Diffusion Plant in Paducah, Kentucky; Portsmouth Gaseous Diffusion Plant in Piketon, Ohio; and the Feed Materials Production Center in Fernald, Ohio. After unsuccessful in-house attempts to eliminate/recycle the contaminated metal, DOE is allowing private enterprise the opportunity to participate in this program. DOE is making this opportunity available under a two-phase approach, which is being supported by two separate and corresponding Request for Proposals. Phase I, which is nearing completion, is a demonstration phase to establish a group of companies that the DOE will consider qualified to eliminate the scrap at one or more sites. In Phase I, the companies decontaminated 25-50 tons of scrap to demonstrate capabilities to DOE and to gain the knowledge required to plan/bid on elimination of the scrap at one or more sites. Phase II will request proposals for elimination of the total scrap at one or more of the above noted sites. Multiple awards for Phase II are also anticipated. Companies participating in Phase II will be required to take title to the contaminated scrap and decontaminate/process the scrap for beneficial reuse. Radioactive wastes and metal that cannot be successfully decontaminated/processed will be returned to DOE.

42768 (CONF-871075—Vol.1-Pt.3, pp 351-384) **Control of water infiltration into near surface LLW disposal units.** O'Donnell, E.; Schulz, R.K.; Ridky, R.W. (Univ. of Maryland, College Park (USA)). 1987. NTIS, PC A18/MF A01. Order Number DE88007805/JAW.

From 3. Oak Ridge model conference on waste problems; Oak Ridge, TN, USA (13 Oct 1987).

A procedure named bioengineering management is described which uses engineered features at the surface to ensure adequate runoff. Investigation on that procedure is underway with a pilot study at Maxey Flats, KY and a large scale demonstration at Beltsville, MD and results to date are encouraging. Two types of subsurface features that may be constructed to enhance runoff are described. One is the restrictive layer barrier, and the other is the conductive layer barrier. The restrictive layer barrier is the well known compacted clay layer and depends on compaction of permeable porous materials to obtain low flow rates. Flow through a restrictive layer is described by Darcy's law. Investigations on flow through such layers have gone on for over 100 years, so further progress in this area can be expected to be slow. The conductive layer barrier is based on the capillary barrier concept and has little been investigated. No definitive full scale field experiments have been carried out in humid regions. It is in this relatively unplowed ground that the greatest advances might take place in the near future, is where new effort should be directed.

42769 (CONF-871075—Vol.1-Pt.3, pp 385-402) **Computer modeling of greater confinement disposal of radioactive waste at the Nevada Test Site.** Ebeling, L.L. (Reynolds Electrical & Engineering, Las Vegas, NV (USA)). 1987. NTIS, PC A18/MF A01. Order Number DE88007805/JAW.

From 3. Oak Ridge model conference on waste problems; Oak Ridge, TN, USA (13 Oct 1987).

A 1.1 megaCuri and 3.5 kilowatt waste source has been buried 30 meters down an auger hole in a tuffacaous alluvium for over three years. Temperature and moisture have been monitored in the surrounding soil during this time and two gaseous tracer mi-

gration studies conducted to determine flow parameters. Temperatures exceeding 300°C have been recorded and the moisture range has increased from 10-12% to 2-14%. The tracer migration data is being analyzed. A two-dimensional transient multi-phase and E.P.A. accepted model, WAFE, is being used to simulate this data and make long term performance projections. Many problems associated with precession, array boundaries and local subroutines have been encountered in converting the model which was developed on the Los Alamos National Laboratory's CRAY based computer system to run on a DEC/VAX 750. Documentation, which is still in rough draft, has also made the valid modification of the code or organization of an input data file difficult.

42770 (CONF-871075—Vol.1-Pt.3, pp 403-405) **Low-level waste disposal techniques and experience in France.** Hutchison, C.A.; de Wavrechin, B.; Marque, Y. 1987. NTIS, PC A18/MF A01. Order Number DE88007805/JAW.

From 3. Oak Ridge model conference on waste problems; Oak Ridge, TN, USA (13 Oct 1987).

The Centre de Stockage de la Manche (CSM) is the first near-surface disposal facility for short-lived, low- and medium-level radioactive waste in France. This paper will provide background on the regulatory framework applicable to low-level waste management in France, and will describe the siting, design and operation of the CSM as well as the integrated waste management system of which it is a part.

42771 (CONF-871075—Vol.1-Pt.3, pp 437-439) **Methodology for the characterization of low-level radioactive waste at the Oak Ridge National Laboratory.** Costanzo, D.A. Peretz, F.J. (Oak Ridge National Lab., TN (USA)). 1987. NTIS, PC A18/MF A01. Order Number DE88007805/JAW.

From 3. Oak Ridge model conference on waste problems; Oak Ridge, TN, USA (13 Oct 1987).

Low-level liquid radioactive waste originates from a number of different source facilities at the Oak Ridge National Laboratory (ORNL). Sources include reactors, radioactive fuel and target processing facilities, decontamination operations, hot cells, and analytical laboratories. Waste generated at these source facilities are collected in storage tanks distributed throughout ORNL. Many of the source facilities generate acidic nitrate wastes which are neutralized with sodium hydroxide in the collection storage tanks. The stored waste is essentially a high-pH, sodium nitrate, salt solution with smaller concentration of potassium, calcium, and magnesium cations, and sulfate chloride, fluoride, and phosphate cations. The principle radionuclides are strontium-90, cesium-137 and cobalt-60. Data on the chemical and physical form of the waste are needed to evaluate the practicality of various processing options and to analyze the resulting waste forms. Data on radiochemical concentrations are needed to predict dose rates and shielding requirements around processing equipment and waste packages and to provide a data base for leach tests and other immobilization requirements. This paper describes chemical and physical measurement techniques that have been used to characterize low-level waste at ORNL.

42772 (CONF-871075—Vol.1-Pt.3, pp 443-445) **Detection and delineation of waste trenches by geophysical methods at Oak Ridge National Laboratory.** Selfridge, R.J. (Maxima Corp. (USA)). 1987. NTIS, PC A18/MF A01. Order Number DE88007805/JAW.

From 3. Oak Ridge model conference on waste problems; Oak Ridge, TN, USA (13 Oct 1987).

Detection and delineation of waste trenches at hazardous waste sites are needed before actual implementation of site corrective measures. In a field study conducted in Solid Waste Storage Area 4 (SWSA4) at Oak Ridge National Laboratory (ORNL), surface geophysical techniques were used to assist in the delineation of waste trenches. A magnetometer/gradiometer survey was used to detect ferrous metals buried at the site. An electromagnetic ground conductivity survey was used to measure the electrical conductivity of the subsurface and aided in supporting the magnetometer/gradiometer results. Results from the two techniques were complimentary and easily integrated into a final interpretation. The reliability, efficiency, and worker safety benefits of these techniques offer a nondestructive surface technique for locating buried waste trenches.

42773 (CONF-8804130—1) **Technical and economic issues related to consistency of quality assurance programs.** Maskarinec, M.P.; Holladay, S.K.; Ryan, M.A.; Dempsey, C. (Army Toxic and Hazardous Materials Agency, Aberdeen Proving Ground, MD (USA); Environmental Protection Agency, Washington, DC (USA)). 1988. Contract AC05-84OR21400. 17p. NTIS, PC A18/MF A03;1; GPO Dep. Order Number DE88010142/JAW.

From 12. aquatic toxicology and hazard assessment symposium; Sparks, NV, USA (24 Apr 1988).

The potential technical benefits of a consistent QA approach include improved overall data quality, improved methods validation procedures, improved data handling and archival systems, and increased utility of all data generated. The economic benefits are primarily due to a sharing of developments between the agencies involved, all of which were funded from public monies. There is an additional benefit in the future reduction of quality assurance costs at contracting laboratories, due to the fact that a single quality assurance system, rather than several, could be used by the laboratory. 5 refs.

42774 (CONF-8804134—2) **Linear free energy relationships in glass corrosion.** Abrajano, T.A. Jr.; Bates, J.K.; Bohlke, J.K. (Argonne National Lab., IL (USA)). 1988. Contract W-31109-ENG-38. 10p. NTIS, PC A02/MF A01; 1; GPO Dep. Order Number DE88012050/JAW.

From Symposium on materials stability and environmental degradation; Reno, NV, USA (5 Apr 1988).

Various theoretical models that have been proposed to correlate glass durability to their composition for a wide variety of silicate, borosilicate, and aluminosilicate glasses are examined. Comparisons are made between the predictions of these models and those of an empirical formulation extracted from existing data in the present work. The empirical approach provides independent confirmation of the relative accuracy of the silica release rate predictions of the different theoretical models in static leaching systems. Extension of the empirical approach used in this work are discussed. 23 refs., 2 figs., 1 tab.

42775 (CONF-8806150—1) **Radioactive solid waste disposal at the Oak Ridge National Laboratory.** Williams, L.C. (Martin Marietta Energy Systems, Inc., Oak Ridge, TN (USA)). 1988. Contract AC05-84OR21400. 23p. NTIS, PC A 03; 3; GPO Dep. Order Number DE88011391/JAW.

From Centre de Stockage de la Manche; Cherbourg, France (16 Jun 1988).

This paper describes the current low-level radioactive solid waste disposal operations for the Oak Ridge National Laboratory (ORNL). Depending on surface radiation levels, waste disposal operations are completed using various techniques and processes. In general, all disposal efforts are conducted by enhanced or greater confinement containment methods. The disposal operations described are (1) waste compaction operations, (2) low- and high-activity silo disposal, (3) supercompaction of waste containers, and (4) tumulus pad disposal.

42776 (DOE/AL/33218—3) **[Analysis of transportation issues]: Final technical report.** Friel, L. (Western Interstate Energy Board, Denver, CO (USA)). 5 Apr 1988. Contract AC02-85AL33218. 40p. NTIS, PC A03/MF A01;1; GPO Dep. Order Number DE88008567/JAW.

Work was carried out with extensive involvement of technical and policy people from the western state governments through the creation of a High-Level Radioactive Waste Committee of the Western Interstate Energy Board. Committee members, who are from governor's offices and state agencies, have committed themselves to developing a thorough technical understanding of the issues so that they can have confidence in the analyses performed by others. The Committee closely directed and contributed to the preparation of work products by the WIEB staff. Activities under the contract were conducted over a 31-month period, during which time the specific tasks were modified and expanded to reflect the needs and interests of the Department of Energy and the HLW Committee.

42777 **(DOE/CH/10140—05(87)) Bibliography of studies for the Salt Repository Project Office of the Civilian Radioactive Waste Management Program, April 1978-June 1987.** (Battelle Memorial Inst., Columbus, OH (USA). Office of Nuclear Waste Isolation). Sep 1987. Contract AC02-87CH10290;AC02-83CH10140. 323p. (BMI/ONWI/C—9). H. Order Number TI88012836/JAW.

This report is an annotated bibliography of approved reports that have been produced for the US Department of Energy Salt Repository Project Office of the Civilian Radioactive Waste Management Program since April 1978. This document is intended for use by the US Department of Energy, State and local officials, the US Nuclear Regulatory Commission, contractors to the Office of Nuclear Waste Isolation, concerned citizens, and others who need a comprehensive listing of reports related to a nuclear waste repository in salt. This document consists of a main report listing, appendixes with Work Breakdown Structure lists, and a topical index.

42778 **(DOE/CH/10270—T1) Lower Sioux Indian Community Repository Research Project: Final report.** O'Brien, L.; Farmer, D.; Lewis, S. (Lower Sioux Indian Community, Morton, MN (USA)). 5 Apr 1988. Contract FG02-86CH10270. 4p. NTIS, PC A08/MF A01;1; GPO Dep. Order Number DE88008519/JAW.

The Upper and Lower Sioux Communities have undertaken a review of the geotechnical aspects of the Department of Energy (DOE) program document entitled Draft Area Recommendation Report (DARR). The DARR recommends twenty sites be retained for continued consideration as a possible location for the second high-level nuclear waste repository. Of these twenty sites, twelve are designated as Potentially Acceptable Sites (PAS), and eight are designated as candidate areas to serve as {open←quotes}backups{close←quotes} to the PAS's. It is understood there are no current plans to investigate any of the eight candidate areas. It is distressing to the Upper and Lower Sioux Communities that the DOE intends to hold these eight sites in reserve. We do not feel it is appropriate to identify {open←quotes}reserve{close←quotes} sites which could be elevated to a PAS at any time during the area phase of investigation. The following chapters in this report provide a summary of the specific procedural and technical problems noted in the screening methodology; and describe our concerns over the selection of NC-13 and NC-14 as reserve sites. Also included are the specific comments recorded by our technical subcontractors as they examined the DARR for us. 10 refs.

42779 **(DOE/CH/46664—03(1)) Permian Basin, Texas: Volume 1, Text: Final preliminary design report.** (Parsons Brinckerhoff, Houston, TX (USA)). Jan 1988. Contract AC02-87CH10290;AC97-86WM46664. 760p. (BMI/ONWI/C—77). H. Order Number DE88013574/JAW.

This report is a description of the preliminary design for an Exploratory Shaft Facility (ESF) at the proposed 49 acre site located 21 miles north of Hereford, Texas in Deaf Smith County. Department of Energy must conduct in situ testing at depth to ascertain the engineering and environmental suitability of the site for further consideration for nuclear waste repository development. The ESF includes the construction of two 12-ft diameter engineered shafts for accessing the bedded salt horizon to conduct in situ tests to ascertain if the site should be considered a candidate site for the first High Level Nuclear Waste Repository. This report includes pertinent engineering drawings for two shafts and all support facilities necessary for shaft construction and testing program operation. Shafts will be constructed by conventional drill-and-blast methods employing ground freezing prior to shaft construction to stabilize the existing groundwater and soil conditions at the site. A watertight liner and seal system will be employed to prevent intermingling of aquifers and provide a stable shaft throughout its design life. 38 refs., 37 figs., 14 tabs.

42780 **(DOE/ID/12576—T8) Host State Screening Process: Regional Management Plan.** Drobny, N.L. (Midwest Interstate Low-Level Radioactive Waste Commission, St. Paul, MN (USA); ERM-Midwest, Inc., Columbus, OH (USA)). 29 Jul 1986. Contract FG07-85ID12576. 131p. NTIS, PC A07;3. Order Number DE88012161/JAW.

This report discusses the procedure and criteria that the Commission selected for designating a host state, should a state not volunteer for this role. Section 2 describes the wide range of approaches considered. Advantages and disadvantages of each are reviewed briefly, and the overall timetable established by the Commission for host state selection is presented. Section 3 describes the selected process for host state designation which involves emphasis on waste quantities generated and transportation factors. Section 4 presents relevant data on characteristics of wastes presently generated and presents estimates for future waste generation to Year 2015. Section 5 presents the results of transportation analyses considering the distance over which waste would be transported and safety (accident) statistics for waste transport routes. Section 6 integrates the conclusions from the analysis of waste volumes generated and transportation factors and suggests how these results might be used to designate a host state. 11 refs., 6 figs., 9 tabs.

42781 **(DOE/ID/12576—T11) Screening criteria for siting waste management facilities: Regional Management Plan.** (Midwest Interstate Low-Level Radioactive Waste Commission, St. Paul, MN (USA)). 15 Jul 1986. Contract FG07-85ID12576. 88p. NTIS, PC A05/MF A01; 1; GPO Dep. Order Number DE88012158/JAW.

The Midwest Interstate Low-Level Radioactive Waste Commission (Midwest Compact) seeks to define and place into operation a system for low-level waste management that will protect the public health and safety and the environment from the time the waste leaves its point of origin. Once the system is defined it will be necessary to find suitable sites for the components of that waste management system. The procedure for siting waste management facilities that have been chosen by the compact is one in which a host state is chosen for each facility. The host state is then given the freedom to select the site. Sites will be needed of low-level waste disposal facilities. Depending on the nature of the waste management system chosen by the host state, sites may also be needed for regional waste treatment facilities, such as compactors or incinerators. This report provides example criteria for use in selecting sites for low-level radioactive waste treatment and disposal facilities. 14 refs.

42782 **(DOE/ID/12576—T12) Assessment of impacts from different waste treatment and waste disposal technologies: Regional Management Plan.** (Midwest Interstate Low-Level Radioactive Waste Commission, St. Paul, MN (USA)). 23 May 1986. Contract FG07-85ID12576. 90p. NTIS, PC A05/MF A01;1; GPO Dep. Order Number DE88012157/JAW.

This report presents assessments of treatment and disposal technologies that appear to be appropriate for use in regional facilities in the Midwest Compact Region. Treatment technologies assessed are: compaction with a supercompactor, incineration, and incineration followed by solidification of the incinerator ash. Disposal technologies assessed are: shallow land burial, considered a baseline for comparison of other technologies, below-ground and above-ground vaults, the earth mounded concrete bunker, improved shallow land burial, modular concrete canister disposal, mined cavities, unlined and lined augered holes. The text indicates that assessment of treatment technologies sometimes depends on the disposal technology that will be used, and vice versa. However, the major thrust of assessments reported here is to evaluate the technologies without defining combinations of treatment and disposal methods. 20 refs.

42783 **(DOE/ID/12576—T13) Assessment of waste characteristics and waste management practices for the Midwest Compact Region: Regional Management Plan.** (Midwest Interstate Low-Level Radioactive Waste Commission, St. Paul, MN (USA)). 1 Jun 1986. Contract FG07-85ID12576. 66p. NTIS, PC A04/MF A01;1; GPO Dep. Order Number DE88012156/JAW.

This report has described how the Midwest Compact region's low-level radioactive waste characteristics were determined and has provided assessments of several key characteristics of the waste. Sources of the data used and comments on the validity and uncertainty of both the raw information and the region-wide estimates that have been generated are indicated. The contents and organization of the computerized Midwest Data Base are also presented. This data base is a resource for rational development of the

Midwest Compact's Regional Management Plan. The value of the level of detail contained in Midwest Data Base is demonstrated in its use to analyze the viability of LLW treatment alternatives in other aspects of the regional management plan (RAE86). 10 refs., 7 figs., 13 tabs.

42784 **(DOE/ID/12576—T15) Identification of the recommended waste management systems and system development schedules: Regional Management Plan.** (Midwest Interstate Low-Level Radioactive Waste Commission, St. Paul, MN (USA)). 28 Jul 1986. Contract FG07-85ID12576. 107p. NTIS, PC A06/MF A01;1; GPO Dep. Order Number DE88012159/JAW.

This report describes the evaluations of alternatives for low-level waste treatment and disposal leading to the selection of four disposal methods and two treatment alternatives (including the alternative of only continuing current methods of waste treatment used by the waste generators) that were used to form candidate waste management systems. The subsequent evaluation of waste management systems and schedules for the development of the regional waste management system under four different scenarios are also included. The report also describes the consequences to the member states and their waste generators of the four scenarios and presents insights into preferred courses of action that arise from the scheduling exercise. 13 refs., 14 figs., 2 tabs.

42785 **(DOE/ID/12576—T16) Plans for dealing with loss of access to the Midwest Compact Regional Disposal Facility: Regional Management Plan.** (Midwest Interstate Low-Level Radioactive Waste Commission, St. Paul, MN (USA)). 28 Jul 1986. Contract FG07-85ID12576. 37p. NTIS, PC A03/MF A01;1; GPO Dep. Order Number DE88012160/JAW.

This report describes events that could lead to the premature closure of a disposal facility and the prospects that the closed facility could eventually be reopened. Possible courses of action leading to disposal outside the Midwest region while the Midwest Compact works to reestablish a regional disposal capability are also discussed. A likely division of responsibilities between the Compact Commission and the individual member states, with emphasis on managing low-level waste after a loss of access when disposal outside the Midwest is not possible is presented. Key elements in an agreement between compacts to accept each other's waste when one compact has experienced an unexpected interruption of its disposal operation are described.

42786 **(DOE/ID/12576—T17) Host state incentives and compensation: Regional Management Plan.** (Midwest Interstate Low-Level Radioactive Waste Commission, St. Paul, MN (USA)). 30 Jun 1986. Contract FG07-85ID12576. 37p. NTIS, PC A03;3. Order Number DE88012155/JAW.

The purpose of this incentive report is to present a model incentive and compensation package and to examine the factors that might be addressed in implementing a host state incentive and compensation program. The package is intended to be available to a community and state that volunteers or that is designated by the Commission to host a radioactive waste disposal facility. This report incorporates comments received from the Commission on a draft version of the report dated February 28, 1986. 10 refs., 4 tabs.

42787 **(DOE/RW—86.133) Progress report for 1985/1986 from the Waste Treatment and Disposal Working Party covering joint funded work.** Claxton, D.G.S.A. (Department of the Environment, London (UK). Radioactive Waste (Professional) Div.). 1986. vp. British Library Document Supply Centre, Wetherby, Boston Spa, W. Yorks. .

The Waste Treatment and Disposal Working Party (WTDWP) covered the areas of: ILW Product Evaluation, ILW and HLW Disposal Studies and ILW and HLW Quality Checking. The objectives of the programme were to evaluate potential waste products arising from the treatment of ILW, and to develop appropriate techniques which could be used to check the quality of the finished waste product.

42788 **(DOE/RW—87.056) Progress report for 1986 from the Plutonium Contaminated Materials Working Party.** Higson, S.G. (Department of the Environment, London (UK). Radioactive Waste (Professional) Div.). Nov 1987. 78p. British Library Document Supply Centre, Wetherby, Boston Spa, W. Yorks. .

The paper covers progress during 1986 under the joint BNFL/MOD/DoE funded PCM Working Party studying the management, treatment and immobilization of plutonium contaminated materials. Development is reported under each of seven main programme headings including reduction of arisings, Pu measurement, decommissioning and non-combustible PCM treatment, liquid effluent treatment, sorting and packaging, PCM immobilisation and engineering objectives.

42789 **(DOE/RW—87.100-Vol.1) Radiological assessment of the disposal of high level radioactive waste on or within the sediments of the deep ocean bed: Vol. 1. Main report.** Kane, P. (Department of the Environment, London (UK). Radioactive Waste (Professional) Div.). Nov 1987. 305p. NTIS (US Sales Only), PC A14/MF A01. Order Number DE88753400/JAW.

The contract report comprises a main report accompanied by three volumes detailing the probabilistic risk assessments carried out for each proposed mode of HLW emplacement. Following a section describing the methodology employed, the models developed for and used in the assessment are described. Aspects of design, testing and calibration are covered. The data employed are described in relation to components of the disposal system, giving sources and reasons for the distribution used. Uncertainties in model predictions are examined in relation to their origin. Detailed results are presented which illustrate the transport behaviour of radionuclides in deep ocean environments. Conclusions are drawn and recommendations made for further research.

42790 **(DOE/RW—87.100-Vol.2) Radiological assessment of the disposal of high level radioactive waste on or within the sediments of the deep ocean bed: Vol. 2. Results: penetrator option.** Kane, P. (Electrowatt Engineering Services Ltd., Horsham (UK)). (Department of the Environment, London (UK). Radioactive Waste (Professional) Div.). Nov 1987. 362p. NTIS (US Sales Only), PC A16/MF A01. Order Number DE88753401/JAW.

This report contains the results of the post emplacement probabilistic risk assessment case studies carried out for the penetrator option. The results are mostly presented in graphical form. This document is intended primarily for reference and has been produced in support of the main report. A systematic presentation of results by nuclide chain forms the bulk of the report preceded by sections detailing the methodology employed, the data used and a discussion of the combined risks from all nuclides and followed by the results of several stochastic sensitivity studies. A section describing the 2-D radionuclide transport work is included. A mean maximum risk of $3 \times 10^{-12} y^{-1}$ is predicted at 144,000y. The principal contributing nuclides are Tc-99 and Se-79 to 300,000y with Cs-135 becoming increasingly more significant at later time.

42791 **(DOE/RW—87.100-Vol.3) Radiological assessment of the disposal of high level radioactive waste on or within the sediments of the deep ocean bed: Vol. 3. Results: drill option.** Kane, P. (Department of the Environment, London (UK). Radioactive Waste (Professional) Div.). Nov 1987. 186p. NTIS (US Sales Only), PC A09/MF A01. Order Number DE88753402/JAW.

This report contains the results of the post emplacement probabilistic risk assessment case studies carried out for the drill option. The results are mostly presented in graphical form. This document is intended primarily for reference and has been produced in support of the main report. A systematic presentation of results by nuclide chain forms the bulk of the report preceded by sections detailing the methodology employed, the data used and a discussion of the combined risks from all nuclides. A mean maximum risk of $7 \times 10^{-3} y^{-1}$ is predicted at 192,500y. The principal contributing nuclides are Tc-99 and Se-79 to 2×10^{6}y with Cs-135

at later times. None of the actinides disposed are predicted to contribute to risk.

42792 **(DOE/RW—87.100-Vol.4) Radiological assessment of the disposal of high level radioactive waste on or within the sediments of the deep ocean bed: Vol. 4. Results: seabed option.** Kane, P. (Department of the Environment, London (UK). Radioactive Waste (Professional) Div.). Nov 1987. 290p. NTIS (US Sales Only), PC A13/MF A01. Order Number DE88753403/JAW.

This report contains the results of the post emplacement probabilistic risk assessment case studies carried out for the seabed repository mode of HLW disposal. The information given is intended primarily for reference and has been produced in support of the main report. A systematic presentation of results by nuclide chain forms the bulk of the report preceded by a presentation of the combined risks. For each nuclide chain studied, the stochastic results are in the form of mean risk estimates and distributions of risk at time. Detailed deterministic results are included to illustrate the factors influencing transport and risk. A mean maximum risk of 5 x $10^{-12}y^{-1}$ is predicted at 44,500y. The principal contributing nuclides are Tc-99 and Se-79 to 300,000y with Cs-135 becoming increasingly more significant at later times.

42793 **(DOE/RW—87.124) Evaluation of environmental change and its effects on the radiological performance of a hypothetical shallow engineered disposal facility at Elstow, Bedfordshire.** (Department of the Environment, London (UK). Radioactive Waste (Professional) Div.; Dames and Moore International, Twickenham (UK)). Mar 1988. 146p. NTIS (US Sales Only), PC A07/MF A01. Order Number DE88753404/JAW.

The results of a project designed to evaluate aspects of a hypothetical facility for disposal of radioactive wastes at Elstow, Bedfordshire, are described. The project included modelling of environmental change using the TIME2 code, groundwater flow modelling, biosphere modelling and risk analysis using the SYVAC A/C code. The aims of the work were to demonstrate use of TIME2, investigate the evolution of the facility's environment and to evaluate the influence of environmental change on estimates of radiological risk. Risk analysis of several time-independent environmental system states, using data obtained from the other tasks, indicated that environmental changes significantly influence estimates of radiological risk.

42794 **(DOE/RW—0194) Records management policies and requirements.** (USDOE Office of Civilian Radioactive Waste Management, Washington, DC). Jul 1988. 38p. H; GPO Dep. Order Number DE88013611/JAW.

The Records Management Policies and Requirements (RMPR) establish policies and requirements and assign responsibility for the identification, collection, organization, processing and storage of records of the civilian radioactive waste management program in order to document, and facilitate the review of program activities. This report covers the control, indexing, microfilming, storage, retention, preservation, and protection of records generated by Office of Civilian Radioactive Waste Management (OCRWM) and of program-related documents generated and received from other entities, such as regulatory agencies, States, and Indian Tribes. This document is applicable to OCRWM Headquarters and OCRWM Project Offices.

42795 **(EPRI-NP—5483) BWR [boiling water reactor] radwaste precoat filter optimization: Final report.** Vance, J.N. (Vance and Associates, Ruidoso, NM (USA)). Apr 1988. 77p. Research Reports Center, Box 50490, Palo Alto, CA 94303. Order Number TI88008580/JAW.

This final report describes the work performed at two operating BWR's to optimize the throughput efficiency (in terms of gallonsft^2) of the precoat filters in radwaste equipment drain and floor drain service. The work included laboratory and full-scale testing of various precoat and body feed materials to establish optimum dosages to maximize throughput efficiencies. Cationic coagulant aids were also tested in combination with various body feed materials. 30 figs., 14 tabs.

42796 **(EPRI-NP—5745M) Performance assessment for low-level waste disposal facilities: Interim report.** Shuman, R.; Rogers, V.C.; Chau, N.; Merrell, G.B.; Rogers, V. (Electric Power Research Inst., Palo Alto, CA (USA); Rogers and Associates Engineering Corp., Salt Lake City, UT (USA)). Apr 1988. 74p. Research Reports Center, Box 50490, Palo Alto, CA 94303. Order Number TI88008578/JAW.

The primary differences among most low-level radioactive waste (LLR) disposal technologies are the ways in which concrete is used to construct the disposal units themselves. The BARRIER code has been developed to project the long-term performance and degradation of disposal facilities which use concrete components. BARRIER models unsaturated water flow, concrete degradation, structural failure, contaminant leaching, contaminant transport, foodchain uptake, and annual radiation doses to individuals. Radiological assessments of four disposal facilities at humid and arid sites are performed. The effects of the more aggressive chemical environment at the arid site are apparent in the times to onset of corrosion, concrete loss rates due to sulfate attack, and waste form degradation rates. These harsher conditions result in more rapid deterioration of the concrete structures. Times to the onset of cracking are typically shorter at the arid site than those at the humid site. The BARRIER methodology represents a major step toward better understanding long-term performance of alternative LLW disposal technologies. In addition to directly supplying criteria by which technologies may be compared, the BARRIER code is a valuable tool for improving the design of LLW disposal facilities. 22 refs., 14 figs., 6 tabs.

42797 (IAEA-SR—110(bk.), pp 83-105) **IAEA programme for low-and intermediate-level waste management.** Saire, D.E.; Baehr, W.; Hirling, J. (International Atomic Energy Agency, Vienna (Austria). Div. of Nuclear Fuel Cycle). 1986. NTIS (US Sales Only), PC A99/MF A01. Order Number DE88702505/JAW. (CONF-861065—).

From Seminar on management options for low and intermediate level wastes in Latin America; Rio de Janeiro, Brazil (13 Oct 1986).

The International Atomic Energy Agency's programme activities in the area of low-and intermediate-level waste management are described. The activities relating to assistence to Member States generating radioactive wastes from hospitals, industry and institutional users of isotopes are emphasized. The mechanisms used by the Agency to disseminate information, offer training and provide technical assistence to Member States developing and implementing national, low-and intermediate-level waste management programmes. The Agency's criteria for providing technical assistance, details of technical advices and recommendations to Member States based on the level of radioisotope uses and quantity of waste generated.

42798 (IAEA-SR—110(bk.), pp 396-406) **IEN Low-level-radioactive waste Management.** Rocha, A.C.S. da; Pina, J.L.S.; Silva, S. da; Silva, J.J.G. (Instituto de Engenharia Nuclear, Rio de Janeiro (Brazil)). 1986. NTIS (US Sales Only), PC A99/MF A01. Order Number DE88702505/JAW. (CONF-861065—).

From Seminar on management options for low and intermediate level wastes in Latin America; Rio de Janeiro, Brazil (13 Oct 1986).

The control, treatment and disposal of the low-level radioactive waste produced in the units of IEN-CNEN, in Brazil are presented, in details. These wastes are generated from a particle accelerator (CV-28 cyclotron), radiochemistry laboratories and a nuclear research reactor (Argonaut type).

42799 (IAEA-SR—110(bk.), pp 407-430) **Management for low and intermediate level wastes in Brazil.** Franzen, H.R. (Comissao Nacional de Energia Nuclear de Brasil, Rio de Janeiro). 1986. NTIS (US Sales Only), PC A99/MF A01. Order Number DE88702505/JAW. (CONF-861065—).

From Seminar on management options for low and intermediate level wastes in Latin America; Rio de Janeiro, Brazil (13 Oct 1986).

A research and demonstration project was developed, to offer management options for low and intermediate level radioactive wastes. The project considered: the experience of other countries; the laws and regulations according to internationally accepted standards; criteria and recommendations; the technical, socio-political realities, and the expectation of our countrie related to the nuclear power plants. Preliminary guidelines for waste acceptance critetia were established. The solution for shallow land burial was a multibarrier system. Since, there is no final decision about the repository localization it was decided that the waste produced by nuclear power plants will be kept on-site and those from medicine, agriculture, industry and research are sent to the IPEN/CNEN-SP for treatment and temporary storage. (Author/M.C.K.).

42800 (IAEA-SR—110(bk.), pp 442-473) **Design and operational experience of the centre for the collection treatment and storage of low level radioactive wastes.** Zorrilla, S. (Instituto Nacional de Investigaciones Nucleares, Mexico City). 1986. (In Spanish). NTIS (US Sales Only), PC A99/MF A01. Order Number DE88702505/JAW. (CONF-861065—).

From Seminar on management options for low and intermediate level wastes in Latin America; Rio de Janeiro, Brazil (13 Oct 1986).

The activities of the Centre for Collection, Treatment and Storage of Low-Level Radioactive Wastes (CRTADRBN) are presented. The objective of this centre is the final storage of radioactive waste and radiation sources generated by medicine, industry teaching and research. Safety, storage capacity and economy are considered in the design. The types of treatment for liquid wastes are described and the containement system is specified. (M.C.K.).

42801 (IAEA-SR—110(bk.), pp 510-557) **Spanish experience in managing low and intermediate activity radioactive wastes.** Granero, J.J. (Consejo de Seguridad Nuclear, Madrid (Spain)). 1986. NTIS (US Sales Only), PC A99/MF A01. Order Number DE88702505/JAW. (CONF-861065—).

From Seminar on management options for low and intermediate level wastes in Latin America; Rio de Janeiro, Brazil (13 Oct 1986).

The Spanish experience in management of low and intermediated level radioactive wastes is presented. The radioactive wastes stored come from research reactors, nuclear power plants, nuclear fuel cycle, scientific research, radiodiagnostic and medical applications. The commonest method is incorporation in cement inside special drums, even though some facilities use processes based on urea formal dehyde and on asphalt. Transport of the wastes is carried out by private undertakings and the Nuclear Energy Board. The sites used for storing are temporary in nature. The wastes produced by nuclear power plants are stored on site, with those processed by the Nuclear Energy Board are taken to a province of Cordoba. The National Company ENRESA for managing of all kinds of wastes was created. The Spanish legislation on this subject and the research being carried out by Spain itself and in cooperation with other States, are described.

42802 (IAEA-SR—110(bk.), pp 569-613) **Criteria for the siting, construction, management and evaluation of low and intermediate activity radioactive waste storage.** Granero, J.J. (Consejo de Seguridad Nuclear, Madrid (Spain)). 1986. (In Spanish). NTIS (US Sales Only), PC A99/MF A01. Order Number DE88702505/JAW. (CONF-861065—).

From Seminar on management options for low and intermediate level wastes in Latin America; Rio de Janeiro, Brazil (13 Oct 1986).

The experience acquired by Spain for the storage of low and intermediate level radioactive wastes, is presented. General considerations related to the technology, financing, administrative measures and risk determination are done. The criteria of site selection for construction and management of the waste storage facility are described, evaluating the specific criteria for the licensing procedure, and taking in account the safety and the radiation protection during periods of the system operation. (M.C.K.).

42803 (IAEA-SR—110(bk.)) **Proceedings of the Seminar on Management Options for Low and Intermediate Level Wastes in Latin America.** (International Atomic Energy Agency, Vienna (Austria)). 1986. 614p. (CONF-861065—). NTIS (US Sales Only), PC A99/MF A01. Order Number DE88702505/JAW.

From Seminar on management options for low and intermediate level wastes in Latin America; Rio de Janeiro, Brazil (13 Oct 1986).

These papers are the full tests of the IAEA-SR--110 Abstracts.

The solutions adopted for management problems on radioactive wastes of nuclear installations and contamined materials generated in hospitals, research centers, laboratories in the countries of Latin America are presented. The criteria of site selection for radioactive waste installation and the methods for treating and storage are evaluated. The results of inspections in installations which handle radioactive wastes are done. (M.C.K.).

42804 (IAEA-SR—110(bk.), pp 38-43) **Management of hospital radioactive wastes.** Mantrana, D. (Centro de Investigaciones Nucleares, Montevideo (Uruguay)). 1986. (In Spanish). NTIS (US Sales Only), PC A99/MF A01. Order Number DE88702505/JAW. (CONF-861065—).

From Seminar on management options for low and intermediate level wastes in Latin America; Rio de Janeiro, Brazil (13 Oct 1986).

The general structure of a regulatory scheme for the management of hospital radioactive wastes is presented. The responsabilities of an institution in the radioactive waste management, and storage conditions are defined. The radioactive wastes are classified in physical terms, and the criteria for evaluating the activity of solid wastes are described. The container characteristics and, the types of treatments given to the wastes are specified. (M.C.K.).

42805 (IAEA-SR—110(bk.), pp 189-199) **Waste management in the mine and mill industrial complex of Pocos de Caldas plateau.** Tomida, E.K.; Antunes, I.M.; Figueiredo, N. (NUCLEBRAS, Belo Horizonte (Brazil)). 1986. NTIS (US Sales Only), PC A99/MF A01. Order Number DE88702505/JAW. (CONF-861065—).

From Seminar on management options for low and intermediate level wastes in Latin America; Rio de Janeiro, Brazil (13 Oct 1986).

The waste management flow chart of the uranium mine and mill industrial complex of Pocos de Caldas Plateau, M.G., in Brazil is presented. This industrial complex has two operational divisions: the mine and the mill. The equipments and processes for waste management of both divisions, are described, showing treatment systems and waste containment for environmental protection. (M.C.K.).

42806 (IAEA-SR—110(bk.), pp 200-212) **Evaluation of solidified cement waste forms.** Rzyski, B.M.; Suarez, A.A. (Instituto de Pesquisas Energeticas e Nucleares, Sao Paulo (Brazil)). 1986. NTIS (US Sales Only), PC A99/MF A01. Order Number DE88702505/JAW. (CONF-861065—).

From Seminar on management options for low and intermediate level wastes in Latin America; Rio de Janeiro, Brazil (13 Oct 1986).

A part of the program of the treatment of low and intermediate-level liquid wastes, is presented. The concrete has been suggested as a encapsulation or overpack material for long-term storage of radioactive waste from the nuclear fuel cycle, particularly in conjunction with the disposal of lowand intermediate-level waste. The influence of sodium nitrates, as a possible integrating component of waste, on some properties of national Portland cement, was investigated. The waste form properties, discussed in terms of their dependency on waste type and amount, include water/cement ratio, setting times, compressive strength and homogeneity. Criteria to be applied in the assessment of the final solidified waste are proposed.

42807 (IAEA-SR—110(bk.), pp 213-231) **Treatment of low and intermediate level liquid wastes by chemical precipitation.** Gompper, K. (Kernforschungszentrum Karlsruhe G.m.b.H. (Germany, F.R.). Inst. fuer Nukleare Entsorgungstechnik). 1986. NTIS (US Sales Only), PC A99/MF A01. Order Number DE88702505/JAW. (CONF-861065—).

From Seminar on management options for low and intermediate level wastes in Latin America; Rio de Janeiro, Brazil (13 Oct 1986).

Various liquid waste types to be treated by precipitation are presented. The advantages of α and β,γ-emitter-separation in terms of decontamination of the waste solutions before further the treatment and concentration of the activity into small volumes are shown. The basic mechanisms for precipitation are explained, considering solubility of the product, the coprecipitation, the addition of inactive ions, and influence of pH. The separation of the precipitation sludges by sedimentation, centrifugation and filtration techniques is discussed. The precipitation conditions and specific reagents are given. The decontamination factors for the main α-and β,γ- emitters were obtained, considering the substances which improve and disturb the precipitation process. Some examples of treatment processes of liquid wastes from nuclear research installations, nuclear power plants and fuel reprocessing plants, are given.

42808 (IAEA-SR—110(bk.), pp 232-241) **Experience on the operation of a low-level solid waste treatment facility.** Miyamoto, H.; Suarez, A.A.; Vicente, R. (Instituto de Pesquisas Energeticas e Nucleares, Sao Paulo (Brazil)). 1986. NTIS (US Sales Only), PC A99/MF A01. Order Number DE88702505/JAW. (CONF-861065—).

From Seminar on management options for low and intermediate level wastes in Latin America; Rio de Janeiro, Brazil (13 Oct 1986).

The modifications carried out in the compacting installations of low-level solid radioactive wastes at IPEN-CNEN/SP, in Brazil, are described. The radionuclides present in the solid wastes are presented and, the types of compactible wastes and non-compactible wastes are specified. The waste management systems and the procedures associated to the radiation protection are detailed. (M.C.K.).

42809 (IAEA-SR—110(bk.), pp 242-244) **Conditioning liquid waste from I-131 production by natural TeO_2 neutron irradiation.** Dalaqua Junior, L.; Dellamano, J.C. (Instituto de Pesquisas Energeticas e Nucleares, Sao Paulo (Brazil)). 1986. NTIS (US Sales Only), PC A99/MF A01. Order Number DE88702505/JAW. (CONF-861065—).

From Seminar on management options for low and intermediate level wastes in Latin America; Rio de Janeiro, Brazil (13 Oct 1986).

The treatment techniques assayed to decontamination and volume reduction of the waste from I-131 production, are described. The assayed techniques were: $(NH_4)_2$ TeO_4 precipitation in alcoholic medium and chemical reduction using Sn^{2+} in acid medium and too Fe^{2+} in alkaline medium. Some considerations about products features and final results, are presented.

42810 (IAEA-SR—110(bk.), pp 306-313) **Volume reduction and toluene recovery from liquid scintillation waste.** Dellamano, J.C.; Dalaqua Junior, L.; Suarez, A.A. (Instituto de Pesquisas Energeticas e Nucleares, Sao Paulo (Brazil)). 1986. NTIS (US Sales Only), PC A99/MF A01. Order Number DE88702505/JAW. (CONF-861065—).

From Seminar on management options for low and intermediate level wastes in Latin America; Rio de Janeiro, Brazil (13 Oct 1986).

A method for reducing the volume of wastes generated in radioimunossay techniques, which use ^3H as radioactive tracer and solutions containing toluene, is presented. The experimental works to evaluate the recovery of the liquid scintillator by NaOH treatment and the distillation process to recover the toluene, which is a carcinogenic agent, are described. The recovered toluene was compared with standard scintillation cocktail using A.R. toluene. (M.C.K.).

42811 (IAEA-SR—110(bk.), pp 314-320) **Incineration facility for combustible solid and liquid radioactive wastes in IPEN-Sao Paulo.** Krutman, I.; Grosche Filho, C.E.; Chandra, U.; Suarez, A.A. (Instituto de Pesquisas Energeticas e Nucleares, Sao Paulo (Brazil)). 1986. NTIS (US Sales Only), PC A99/MF A01. Order Number DE88702505/JAW. (CONF-861065—).

From Seminar on management options for low and intermediate level wastes in Latin America; Rio de Janeiro, Brazil (13 Oct 1986).

A system for incinerating combustible solid and liquid radioactive wastes was developed in order to achieve higher mass and volume reduction of the wastes generated at IPEN-CNEN/SP or received from other institutions. The radioactive wastes for incineration are: animal carcasses, ion-exchange resins, contaminated lubricant oils, cellulotic materials, plastics, etc. The process was optimized considering: selection of better construction and insulating materials; dimensions; modular design of combustion chambers to increase burning capacity in future; applicability for various types of wastes; choise of gas cleaning system.

42812 (IAEA-SR—110(bk.), pp 321-326) **Design of an evaporator crystallizer for radioactive liquid waste treatment.** Grosche Filho, C.E.; Dellamano, J.C.; Dalaqua Junior, L. (Instituto de Pesquisas Energeticas e Nucleares, Sao Paulo (Brazil)). 1986. NTIS (US Sales Only), PC A99/MF A01. Order Number DE88702505/JAW. (CONF-861065—).

From Seminar on management options for low and intermediate level wastes in Latin America; Rio de Janeiro, Brazil (13 Oct 1986).

The design of an evaporation/crystallization unit for liquid waste treatment is described. The design intend to treat wastes of an I-131 production plant. This design was developed in parallel with the study of chemical treatment techniques to obtain a more safe storage form. Special attention was done for the collecting system of solid product, designed to act as a solid waste container. Considerations about waste composition, waste collection, construction materials and safety of the process necessary to establish a reliable design.

42813 (IAEA-SR—110(bk.), pp 327-338) **Bituminization of simulated waste, spent resins, evaporator concentrates and animal ashes by extrusion process.** Grosche Filho, C.E.; Chandra, U. (Instituto de Pesquisas Energeticas e Nucleares, Sao Paulo (Brazil)). 1986. NTIS (US Sales Only), PC A99/MF A01. Order Number DE88702505/JAW. (CONF-861065—).

From Seminar on management options for low and intermediate level wastes in Latin America; Rio de Janeiro, Brazil (13 Oct 1986).

The results of the study of simulated radwaste, spent ion-exchange resins, borates/evaporator-concentrates and animal ashes, in bituminized form, are presented and discussed. Distilled and oxidized bitumen were used for characterizing the crude material and simulated wastes-bitumen mixtures of varying weight composition 30, 40, 50, 60% by weight the dry waste material. The asphaltine and parafin contents in the bitumens were determined. Some additives and clays were used aiming best characteristics of solidified wastes. For leaching studies, granular ion-exchange resins were loaded with Cs 134 and mixtures of resins-bitumens were prepared. The leaching studies were executed using the IAEA recommendation and the ISO method. It was used a conventional screw-extruder, used in plastic industry, to determine operational conditions and process difficulties. Mixtures resins-bitumen and concentrate-bitumen in differents operational condition were prepared and analysed.

42814 (IAEA-SR—110(bk.), pp 339-353) **Leaching studies on ion exchange resins immobilized in bitumen matrix.** Grosche Filho, C.E.; Chandra, U.; Villalobos, J.P. (Instituto de Pesquisas Energeticas e Nucleares, Sao Paulo (Brazil)). 1986. NTIS (US Sales Only), PC A99/MF A01. Order Number DE88702505/JAW. (CONF-861065—).

From Seminar on management options for low and intermediate level wastes in Latin America; Rio de Janeiro, Brazil (13 Oct 1986).

Many samples of bitumen mixed with ion exchange resin labelled with ^{134}Cs were prepared to study radionuclide leaching from bitumen waste forms. The resins used in tests were nuclear grade mixed cationicaniocic bead resins. Different bitumen types were assayed: two distilled and two oxidized bitumens. Leached fractions were collected accordingly to the recommendation of ISO method, with complete exchange of leachant after each sampling. The volume collected for analysis was one liter. Marinelli beckers were used to improve counting efficiency in a Ge(Li) detector. The diffusion coefficients for samples prepared with distilled and oxidized bitumens were obtained. Mathematical models of transport phenomena applied to cylindrical geometry was employed to fit experimental data aiming to explain leaching mechanism and predict the long time behavior of immobilized radionuclides. (M.C.K.).

42815 (IAEA-SR—110(bk.), pp 354-367) **Method for qualification of cementation process and its application to a vibration mixer.** Vicente, R.; Rzyski, B.M.; Suarez, A.A. (Instituto de Pesquisas Energeticas e Nucleares, Sao Paulo (Brazil)). 1986. NTIS (US Sales Only), PC A99/MF A01. Order Number DE88702505/JAW. (CONF-861065—).

From Seminar on management options for low and intermediate level wastes in Latin America; Rio de Janeiro, Brazil (13 Oct 1986).

The definition of homogeneity is discussed and methods to measure the 'degree of heterogeneity' of waste forms are proposed. The proposed methods were applied to a vibration assisted mixing process. There are many methods to evaluate homogeneity of waste form. The following methods were considered; visual inspection, the use of cement dye as a tracer, scanning of radioactive tracers and measurements of variations of density, water absorption, proposity and mechanical strength across the waste form. The process variables were waste/cement and water/cement ratios, mixer geometry, mixing time, and vibration intensity. Experimental methods and results were statistically analysed and compared with data obtained from samples adopted as the homogeneity standard.

42816 (IAEA-SR—110(bk.), pp 362-372) **Development and design of a cementation process.** Vicente, R. (Instituto de Pesquisas Energeticas e Nucleares, Sao Paulo (Brazil)). 1986. NTIS (US Sales Only), PC A99/MF A01. Order Number DE88702505/JAW. (CONF-861065—).

From Seminar on management options for low and intermediate level wastes in Latin America; Rio de Janeiro, Brazil (13 Oct 1986).

The conceptual design of a facility for the immobilization of intermediate level liquid waste in cement is presented. The cementation process adopted a vibration assisted mixing process. The solidified waste is packed in 200 litres drum with barite concrete lining. The waste package is classified as Type A package for transport.

42817 (IAEA-SR—110(bk.), pp 558-568) **Facility for low-level solid waste treatment.** Vicente, R.; Miyamoto, H. (Instituto de Pesquisas Energeticas e Nucleares, Sao Paulo (Brazil)). 1986. NTIS (US Sales Only), PC A99/MF A01. Order Number DE88702505/JAW. (CONF-861065—).

From Seminar on management options for low and intermediate level wastes in Latin America; Rio de Janeiro, Brazil (13 Oct 1986).

A facility for low-level solid waste compaction, encapsulation and storage is described. Solid wastes are compacted in 200 l drums and stored over concrete platforms covered with canvas, for decay or for interim storage before transport to the final disposal site.

42818 (IAEA-SR—110(bk.), pp 1-15) **Radioactive waste management at the Peruvian Nuclear Energy Institute.** Mallaupoma, M. (Centro Peruano de Energia Nuclear, Lima). 1986. (In Spanish). NTIS (US Sales Only), PC A99/MF A01. Order Number DE88702505/JAW. (CONF-861065—).

From Seminar on management options for low and intermediate level wastes in Latin America; Rio de Janeiro, Brazil (13 Oct 1986).

A brief account of current radioactive liquid waste management practices at the Peruvian Nuclear Energy Institute (IPEN), is presented. The storage and disposal systems and facilities to be provided at the future Peruvian Nuclear Research Centre (CNIP) at Huarangal, 40 km to the North of Lima, are described.

42819 (IAEA-SR—110(bk.), pp 16-29) **Argentina's radioactive waste disposal policy.** Palacios, E. (Comision Nacional de Energia Atomica, Buenos Aires (Argentina)). 1986. (In Spanish). NTIS (US Sales Only), PC A99/MF A01. Order Number DE88702505/JAW. (CONF-861065—).

From Seminar on management options for low and intermediate level wastes in Latin America; Rio de Janeiro, Brazil (13 Oct 1986).

The Argentina policy for radioactive waste disposal from nuclear facilities is presented. The radioactive wastes are treated and disposed in confinement systems which ensure the isolation of the radionuclides for an appropriate period. The safety criteria adopted by Argentina Authorities in case of the release of radioactive materials under normal conditions and in case of accidents are analysed. (M.C.K.).

42820 (IAEA-SR—110(bk.), pp 30-37) **Low-level waste management at the Nuclear Research Center.** Montanez, O.; Blanco, D.; Vallarino, V.; Calisto, W. (Centro de Investigaciones Nucleares, Montevideo (Uruguay)). 1986. (In Spanish). NTIS (US Sales Only), PC A99/MF A01. Order Number DE88702505/JAW. (CONF-861065—).

From Seminar on management options for low and intermediate level wastes in Latin America; Rio de Janeiro, Brazil (13 Oct 1986).

A general overview of low-level radioactive waste management at the Nuclear Investigation Centre (CIN) of Uruguay is presented. The CIN is a pilot centre of research and development of techniques for implementing measurements for radioactive waste storage and control. (M.C.K.).

42821 (IAEA-SR—110(bk.), pp 44-82) **Management of low-level radioactive wastes in Mexico.** Olivares O, L.A. (Instituto Nacional de Investigaciones Nucleares, Mexico City). 1986. (In Spanish). NTIS (US Sales Only), PC A99/MF A01. Order Number DE88702505/JAW. (CONF-861065—).

From Seminar on management options for low and intermediate level wastes in Latin America; Rio de Janeiro, Brazil (13 Oct 1986).

The management system of low level radioactive wastes in Mexico is presented. The radioactive wastes are produced by medical institutions, research establishments and universities as well as in industry, clinics and laboratories. The National Institute of Nuclear Research is the organization responsible for managing these wastes. Mexico classifies its wastes in accordance with the IAEA recommendations. The system of collection and transport, the processes of treatment and the final storage of radioactive wastes, are described. (M.C.K.).

42822 (IAEA-SR—110(bk.), pp 142-176) **Site selection for low and intermediate level radwastes in Brazil.** Castello, A.; Dornelles, G.H.; Barreto, P.M.C. (Comissao Nacional de Energia Nuclear de Brasil, Rio de Janeiro). 1986. NTIS (US Sales Only), PC A99/MF A01. Order Number DE88702505/JAW. (CONF-861065—).

From Seminar on management options for low and intermediate level wastes in Latin America; Rio de Janeiro, Brazil (13 Oct 1986).

The steps of the site selection for low and intermediate level radioactive waste disposal, carried out by Brazilian CNEN are presented. The criteria recommended by IAEA, other international organizations and experts, were adopted. Five regions of interest were selected, considering the low level of pluviometry, demographic density and use of land. The procedures and technical evaluations are described.

42823 (IAEA-SR—110(bk.), pp 286-295) **Conceptual design of shallow ground repository (SGR).** Roehl, J.L.; Franzen, H.R. (Pontificia Univ. Catolica do Rio de Janeiro (Brazil); Comissao Nacional de Energia Nuclear de Brasil, Rio de Janeiro). 1986. NTIS (US Sales Only), PC A99/MF A01. Order Number DE88702505/JAW. (CONF-861065—).

From Seminar on management options for low and intermediate level wastes in Latin America; Rio de Janeiro, Brazil (13 Oct 1986).

A conceptual design to guide the development of the preliminary and final designs of a shallow ground waste disposal site for low and intermediate level radioactive wastes, complying with the Brazilian necessities, interpreted by Brazilian CNEN, is discussed. The general and specific criteria for the design of such installations, considering the reposing period, the isolation of personnel and environment, the operational activities, the characteristics of the site and of the subsoil and the set of necessary installations and services, are presented. An aboveground landfill, with concrete monoliths and concrete packages arranged in stacks disposed on an impermeable soil layer, is proposed. The disposed elements are covered by another impermeable soil stratum.

42824 (IAEA-SR—110(bk.), pp 373-390) **Design and development of a liquid waste storage tank.** Vicente, R. (Instituto de Pesquisas Energeticas e Nucleares, Sao Paulo (Brazil)). 1986. NTIS (US Sales Only), PC A99/MF A01. Order Number DE88702505/JAW. (CONF-861065—).

From Seminar on management options for low and intermediate level wastes in Latin America; Rio de Janeiro, Brazil (13 Oct 1986).

The paper presents the work undertaken to develop the concept of an intermediate-level wate storage tank and the laboratory work aiming at knowing and improving the performance of the associated instrumentation. Results of testes liquid agitador, liquid level indication and alarm devices are presented.

42825 (IAEA-SR—110(bk.), pp 391-395) **Design of a package for encapsulation, transport and final disposal of discarded radium needles.** Villalobos, J.P.; Vicente, R.; Suarez, A.A. (Instituto de Pesquisas Energeticas e Nucleares, Sao Paulo (Brazil)). 1986. NTIS (US Sales Only), PC A99/MF A01. Order Number DE88702505/JAW. (CONF-861065—).

From Seminar on management options for low and intermediate level wastes in Latin America; Rio de Janeiro, Brazil (13 Oct 1986).

The design and building of packages for temporary storage of radium needles used in radiotherapy instruments are presented. These packages may be used to storage industrial sources. Structural, shielding and absorbing materials to define package geometry and encapsulation process were selected. An interim storage scenario to find out the maximum radon leakage rate from the package, was defined. The package has an inner stainless steel cylindrical capsule, in which the radium needles are enclosed with charcoal as an inert absorbing material. The shieldings materials are a 0.5 cm thick lead layer inside a concrete shell of 23 cm thick. The outer package is a 200 liters drum. Tests were done to verify integrities of containment system and shielding. (Author/M.C.K.).

42826 (IAEA-SR—110(bk.), pp 431-441) **Angra 1-Conditioning of radioactive waste and related problems.** Meldonian, N.L. (Comissao Nacional de Energia Nuclear de Brasil, Rio de Janeiro). 1986. NTIS (US Sales Only), PC A99/MF A01. Order Number DE88702505/JAW. (CONF-861065—).

From Seminar on management options for low and intermediate level wastes in Latin America; Rio de Janeiro, Brazil (13 Oct 1986).

The problems presented during the the commissioning of the solid waste processing system of Angra 1, are discussed. Based on the obtained results, some modifications have been introduced in order to get a better final product quality. Such modifications are described and the results compared with those originally obtained. The items related to the preliminary acceptance criteria for radioactive wastes, established by the Brazilian National Nuclear Energy Commission, are discussed, taking into account the final disposal and transportation problems. Considering the final product quality generated in Angra 1, the utility (FURNAS - Centrais Eletricas S.A.) has taken the necessary measures for acquiring a new waste immobilization unit, in order to be in accordance with the acceptance criteria. The paper still presents the method for interim storage on site, the handling procedures for the encapsulated radwastes, as well as, data about the radioactive wastes volume generated, according to their characteristics.

42827 (INIS-mf—11210, pp VII9) **Disposal of radioactive hospital wastes to the Negev and fatal road accidents.** Kalish, Y. (Beilinson Medical Center, Petah Tiqua (Israel). Dept. of Medical Physics). Dec 1987. NTIS (US Sales Only), PC A13/MF A01. Order Number DE88780087/JAW. (CONF-871287—).

From Nuclear Societies of Israel annual meeting; Haifa, Israel (21 Dec 1987).

Transactions.; V. 14.

42828 (JAERI-M—87-215) **Development of elementary models of comprehensive safety assessment model for shallow land disposal of low-level radioactive wastes (3). Modeling of radionuclide leaching from concrete wall of concrete lined drums.** Matsuzuru, Hideo; Wakabayashi, Noriaki. (Japan Atomic Energy Research Inst., Tokyo). Jan 1988. 37p. (In Japanese). NTIS (US Sales Only), PC A03/MF A01. Order Number DE88753425/JAW.

The evaluation model for the prediction of leaching of radionuclides from a concrete wall which lines the inside of a steel drum (concrete lined drum) has been developed to evaluate the source term of a shallow land burial of low-level radioactive wastes. The leaching system to be evaluated here consists of a waste as an infinite source, in which radionuclides uniformly disperse on the macroscopic scale regardless of the time, an infinite liquid phase with a uniform composition, and a concrete wall which contacts with both the liquid phase and the waste. The mass-transport equation derived from the mass balance in the system considered here was solved under the initial and boundary conditions assumed, and the rate equation was derived to describe the leaching of radionuclides from the concrete wall. Numerical analyses have been carried out by using the analysis code (WPLATE) which was developed based on the rate equation, and the effect of the wall on the reduction in the amounts of radionuclides leached has been clarified in relation to the thickness of the wall.

42829 (JAERI-M—88-008) **Volume reduction of ion exchange resins by catalytic incineration, 1. Basic examination.** Yahata, Taneaki; Terakado, Norimitsu; Kurihara, Masayoshi. (Japan Atomic Energy Research Inst., Tokyo). Jan 1988. 29p. (In Japanese). NTIS (US Sales Only), PC A03/MF A01. Order Number DE88753429/JAW.

Thermal decomposition behavior of ion exchange resins has been examined using thermobalance in order to obtain the basic data for incineration of ion exchange resins. Evaporation of water included in the resin occurred below 200 deg C. The anion exchange radical was decomposed between 360 and 480 deg C. For cation exchange radical, the decomposition temperature spread between 280 and 600 deg C. The resin structure base was gradually decomposed over ca 600 deg C. The evaporation of water and decomposition of ion exchange radical were not affected with oxygen pressure, but the thermal decomposition andor incineration of resin base was accelerated with the pressure. Incineration examination has been made using a crucible type furnace in air flow at 600 deg C. Thermal decomposition products from the resins were effectively oxidized by copper monoxide catalyst. Sulfur dioxide SO_2 evolved from cation exchange resin is a poison of this catalyst. However, SO_2 could be fixed with calcium hydroxide. The thermal decomposition products were easily oxidized by the catalyst after elimination of SO_2.

42830 (MLM—3506(OP)) **Recovery of tritium from water.** Sienkiewicz, C.J.; Lentz, J.E. (Monsanto Research Corp., Miamisburg, OH (USA). Mound). 1988. Contract AC04-76DP00053. 6p. (CONF-880505—33). NTIS, PC A02. Order Number DE88012879/JAW.

From 3. topical meeting on tritium technology in fission, fusion and isotopic applications; Toronto, Canada (1 May 1988).

The pilot-scale Combined Electrolysis Catalytic Exchange (CECE) system developed at the US Department of Energy's Mound facility has evolved into a fully operational tritium recovery system. This has resulted from the evaluation of recent developments in AECL/ORNL hydrophobic exchange catalyst in the CECE system. Data obtained during recent tests led to the design and installation of an aqueous tritium recovery facility. Operation of the Tritium Aqueous Waste Recovery System makes possible the recovery of tritium from low-level tritiated aqueous waste streams. 14 refs., 4 figs.

42831 **(NUREG/CR—5137) Biodegradation testing of TMI-2 EPICOR-II waste forms.** Rogers, R.D.; McConnell, J.W. Jr. (Nuclear Regulatory Commission, Washington, DC (USA). Div. of Engineering; EG and G Idaho, Inc., Idaho Falls (USA)). Jun 1988. Contract AC07-76ID01570. 26p. (EGG—2540). NTIS, PC A03/MF A01 - GPO. Order Number TI88012226/JAW.

ASTM biodegradation tests were conducted on waste forms containing high specific activity ion exchange resins from EPICOR-II prefilters. Those tests were part of a program to test waste forms in accordance with the NRC Branch Technical Position on Waste Form. Small waste forms were manufactured using two different solidification agents, Portland Type I-II cement and vinyl ester-styrene (VES). Ion exchange material was taken from two EPICOR-II prefilters; PF-7, which contained all organic material, and PF-20, which contained organic resins and a layer of inorganic zeolites. Test results showed that the VES waste forms supported microbial growth, while cement waste forms did not support that growth. Growth was also observed adjacent to some VES waste forms. Radiation levels found in the ion exchange resins used in this study were not found to inhibit microbial growth. The extent of degradation of the waste forms could not be determined using the ASTM tests specified by the NRC Branch Technical Position on Waste Form. As a result of this work, a different testing methodology is recommended, which would provide direct verification of waste form capabilities. That methodology would evaluate solidification materials without using the ASTM procedures or subsequent compression testing. The proposed tests would provide exposure to a wide range of microbial species, use appropriately sized specimens, provide for possible use of alternate carbon sources, and extend the test length. Degradation would be determined directly by measuring metabolic activity or specimen weight loss. 16 refs., 15 figs., 3 tabs.

42832 **(PNL—5551) Radionuclide release from spent fuel under geologic disposal conditions: An overview of experimental and theoretical work through 1985.** Reimus, P.W.; Simonson, S.A. (Pacific Northwest Lab., Richland, WA (USA)). Apr 1988. Contract AC06-76RL01830. 153p. NTIS, PC A08;3. Order Number DE88008631/JAW.

This report presents an overview of experimental and theoretical work on radionuclide release from spent fuel and uranium dioxide (UO_2) under geologic disposal conditions. The purpose of the report is to provide a source book of information that can be used to develop models that describe radionuclide release from spent fuel waste packages. Modeling activities of this nature will be conducted within the Waste Package Program (WPP) of the Department of Energy's Salt Repository Project (SRP). The topics discussed include experimental methods for investigating radionuclide release, how results have been reported from radionuclide release experiments, theoretical studies of UO_2 and actinide solubility, results of experimental studies of radionuclide release from spent fuel and UO_2 (i.e., the effects of different variables on radionuclide release), characteristics of spent fuel pertinent to radionuclide release, and status of modeling of radionuclide release from spent fuel. Appendix A presents tables of data from spent fuel radionuclide release experiments. These data have been digitized from graphs that appear in the literature. An annotated bibliography of literature on spent fuel characterization is provided in Appendix B.

42833 **(PNL—6517) GEOTHER/VT4: A two-phase groundwater fluid flow and heat transport code for high-level radioactive waste applications.** Bian, S.H.; Budden, M.J.; Bartley, C.L.; Yung, S.C. (Pacific Northwest Lab., Richland, WA (USA); Westinghouse Hanford Co., Richland, WA (USA)). Mar 1988. Contract AC06-76RL01830. 175p. NTIS, PC A08/MF A01;1; GPO Dep. Order Number DE88008436/JAW.

The GEOTHER/VT4 code has been developed at Pacific Northwest Laboratory for the Basalt Waste Isolation Project (BWIP). This code is a modified version of the GEOTHER code developed by the US Geological Survey and later modified by Battelle's Office of Nuclear Waste Isolation (ONWI) for nuclear waste repository simulation. The two-equation model of the original GEOTHER was modified by adding a conduction equation to the model. Other changes were made to the code to make it suitable for simulation of waste repositories. This report gives the detailed derivation of the three-equation model, the numerical solution method, code verification, and input description. Input listings for the benchmark cases used to verify the code are presented. The twelve new subroutines added to the code are also described. These descriptions are followed by a sample output, a discussion of graphics programs for the code, program redimensioning, and bit packing. The current version is suitable only for an environment where noncondensable gases are absent. An improved version is under development to account for the noncondensable gases. 13 refs., 8 figs., 8 tabs.

42834 **(PNL—6539) Laboratory work in support of West Valley glass development.** Bunnell, L.R. (Pacific Northwest Lab., Richland, WA (USA)). May 1988. Contract AC06-76RL01830. 74p. NTIS, PC A04/MF A01;1; GPO Dep. Order Number DE88010610/JAW.

Over the past six years, Pacific Northwest Laboratory (PNL) has conducted several studies in support of waste glass composition development and testing of glass compositions suitable for immobilizing the nuclear wastes stored at West Valley, New York. As a result of pilot-scale testing conducted by PNL, the glass composition was changed from that originally recommended in response to changes in the waste stream, and several processing-related problems were discovered. These problems were solved, or sufficiently addressed to determine their likely effect on the glass melting operations to be conducted at West Valley. This report describes the development of the waste glass composition, WV-205, and discusses solutions to processing problems such as foaming and insoluble sludges, as well as other issues such as effects of feed variations on processing of the resulting glass. An evaluation of the WV-205 glass from a repository perspective is included in the appendix to this report.

42835 **(PNL/SRP-SA—15635) Report on materials characterization center workshop on stress corrosion cracking for the Salt Repository Project, December 16-17, 1986, Seattle, Washington: Workshop summary.** Merz, M.D.; Shannon, D.W. (Pacific Northwest Lab., Richland, WA (USA)). Sep 1986. Contract AC06-76FF02170;AC06-77RL01030. 175p. (CONF-8612142—Summ.; CONF-8612142—). NTIS, PC A08;3. Order Number DE88009489/JAW.

From Materials characterization center workshop on stress corrosion cracking for the salt repository project; Seattle, WA, USA (16 Dec 1986).

The Materials Characterization Center (MCC) at Pacific Northwest Laboratory (PNL) conducted a Workshop on Stress Corrosion Cracking for the Salt Repository Project on December 16 and 17, 1986 in Seattle, Washington. The workshop was held to formulate recommendations for addressing stress corrosion cracking (SCC) in a salt repository. It was attended by 24 representatives from major laboratories, universities, and industry. This report presents the recommendations of the workshop, along with the agenda, list of participants, questions and comments, summaries of working groups on low-strength steel and alternate materials, and materials handed out by the speakers.

42836 **(SAND—87-0039) Interpretations of single-well hydraulic tests conducted at and near the Waste Isolation Pilot Plant (WIPP) Site, 1983-1987.** Beauheim, R.L. (Sandia National Labs., Albuquerque, NM (USA)). Dec 1987. Contract AC04-76DP00789. 168p. NTIS, PC A08/MF A01;1; GPO Dep. Order Number DE88012110/JAW.

Both single-well and multiple-well hydraulic tests have been performed in wells at and near the WIPP site as part of the site hydrogeologic-characterization program. The single-well tests conducted from 1983 to 1987 in 23 wells are the subject of this report. The stratigraphic horizons tested include the uppper Castile Formation; the Salado Formation; the unnamed, Culebra, Tamarisk, Magenta, and Forty-niner Members of the Rustler Formation; the Dewey Lake Red Beds; and Cenozoic alluvium. Tests were also performed to assess the integrity of a borehole plug isolating a pressurized brine reservoir in the Anhydrite III unit of the Castile Formation. The types of tests performed included drillstem tests (DST's), rising-head slug tests, falling-head slug tests, pulse tests, and pumping tests. 68 refs., 146 figs., 3 tabs.

42837 **(SAND—87-1955C) Scale effects in well testing in fractured media.** Beauheim, R.L. (Sandia National Labs., Albuquerque, NM (USA)). 1988. Contract AC04-76DP00789. 37p. (CONF-8806169—1). NTIS, PC A03/MF A01; 1; GPO Dep. Order Number DE88012338/JAW.

From 4. annual Canadian/American conference on hydrogeology; Banff, Canada (22 Jun 1988).

The hydrologic characterization of the Waste Isolation Pilot Plant (WIPP) site in southeastern New Mexico has centered on the Culebra dolomite, a locally fractured unit exhibiting double-porosity behavior. Extensive well testing has been performed in the Culebra at a number of scales: single-well drillstem and slug tests; single-well pumping tests; short-term (1-10 days) pumping tests involving observation wells up to 140 ft away; and long-term (30-60 days) pumping tests involving observation wells at distances of up to 4 miles. Each scale of test provides different and complementary types of information on the interactions between the fractures and the porous matrix, and on the degree and continuity of fracturing. Case histories of tests performed at different scales provide examples of the concepts involved, and the quantititive and qualitative results obtainable. Small-scale (drillstem and slug) tests are most sensitive to the fractures in direct connection with the wellbore, and provide the least opportunity for observable pressure equilibration between fractures and matrix. These tests may indicate a transmissivity different from that obtained from larger scale tests. As the scale of the tests increase, the matrix participates more fully in the hydraulic responses observed. Single-well pumping tests provide a good estimation of the double-porosity parameters affecting pressure responses on a local scale, and may reveal the existence of fracture discontinuities. Short-term pumping tests with relatively close observation wells provide information on the spatial scale over which double-porosity behavior remains distinguishable from single-porosity behavior, as well as information on fracture discontinuities. Finally, long-term pumping tests with distant observation wells illustrate the regional-scale heterogeneous, single-porosity behavior of the system.

42838 **(SAND—87-2223) Feasibility of disposal of high-level radioactive wastes into the seabed: Engineering.** Hickerson, J.; Freeman, T.J.; Boisson, J.Y.; Gera, F.; Murray, N.; Nakamura, H.; Nieuwenhuis, J.D.; Schaller, K.H. (Sandia National Labs., Albuquerque, NM (USA)). Apr 1988. Contract AC04-76DP00789. 238p. NTIS, PC A11/MF A01;1; GPO Dep. Order Number DE88012106/JAW.

This report summarizes the work of the Engineering Studies Task Group (ESTG) of the Seabed Working Group during its study of emplacement systems for the subseabed disposal of high level radioactive waste. ESTG has performed design studies of emplacement systems, costed them, and estimated operational reliabilities. Mathematical models for important physical and engineering processes were developed and a large number of laboratory tests, sea trials, and in situ experiments for the purpose of understanding the emplacement environment and developing the specialized equipment necessary for emplacement were performed. Attention was focused on two systems. The first would emplace a 450-m column of waste packages in predrilled holes 750 m deep. The second would use free falling gravity penetrators launched from a disposal ship to embed waste packages about 50 m below the seafloor in an array that separated each by an average of 180 m from its neighbors. Studies of each system covered all aspects, from the configuration and functions of the port facilities through transport to the ocean site, emplacement operations, and post emplacement behavior of the waste packages. Cost and reliability studies were similarly broad. ESTG concludes that viable disposal systems for subseabed emplacement of waste are feasible. If appropriate sites can be found, it appears that straightforward methods are available for producing satisfactory waste packages that can survive a 500-yr emplacement period. 172 refs., 40 figs., 19 tabs.

42839 **(SAND—87-2859) Model calculations of flow through shaft seals in the Rustler Formation.** Stormont, J.C.; Arguello, J.G. (Sandia National Labs., Albuquerque, NM (USA)). Apr 1988. Contract AC04-76DP00789. 59p. NTIS, PC A04/MF A01;1; GPO Dep. Order Number DE88010605/JAW.

A simple model of one-dimensional darcy flow through shaft seals in the Rustler Formation overlying the WIPP Facility horizon was developed to provide a means of conducting parametric evaluations of seal design and performance. The model provides for a number of intervals in series between the top of the Rustler Formation and the top of the Salado Formation. Each interval has three parallel flow paths (seal material, adjacent rock, and seal/rock interface). Ranges of input values for seal, rock, and interface performance were estimated from available literature and inference. Calculations were performed to determine the sensitivity of the flow rate through the seal system to the type, location, assumed performance, and number of seal components. The seal system response was determined to be most sensitive to permeability of the host rock. Uncertainties regarding the concrete/rock interface and the degradation of the concrete may render the concrete ineffective as a long-term flow barrier. Bentonite, owing to its low permeability and probable long-term stability, may be an acceptable long-term seal material. The results of these calculations highlight data needs that include determination of host rock permeability and measurement and predictions of bentonite stability. 38 refs., 14 figs., 5 tabs.

42840 **Scope and approach to management of mixed wastes: introduction to the session.** Ausmus, B.S. (Bechtel National Inc., Oak Ridge, TN (USA)). *Transactions of the American Nuclear Society;* **52**: 21-22(1986). (CONF-860610—Summs.).

From American Nuclear Society annual meeting; Reno, NV, USA (15 Jun 1986).

Mixed wastes are those that are termed both radioactive and chemically hazardous based on regulatory criteria in the United States. Historically, mixed wastes that could be classified as radioactive wastes were treated, stored, and disposed under statutes governing radioactive wastes. In recent years, it has become apparent that: (a) hazardous wastes are generated in nuclear facilities; (b) many wastes are both radioactive and chemically hazardous; and (c) the management of chemically hazardous wastes and mixed wastes requires reexamination of current waste treatment/disposal methods and development/implementation of modified methods. The purpose of this session is to discuss specific aspects of the mixed waste management problems and to provide a forum for discussion of the technical and institutional barriers to problem solutions. The paper addresses several mixed waste problems and current approaches to their solutions, including: (1) mixed waste management in fuel cycle facilities; (2) mixed waste management in a US Dept. of Energy production facility; and (3) mixed wastes impacts on 10CFR61 compliance. Technical and institutional approaches to mixed waste management are explored in three areas: (1) alternatives for treatment prior to shallow land disposal; (2) potential benefits of recovery of strategic/critical materials from mixed wastes; and (3) shallow land disposal system compatibilities/problems.

42841 **Mixed wastes: the implications for 10CFR61 compliance.** Trinoskey, P.A. (Bechtel National Inc., Oak Ridge, TN (USA)). *Transactions of the American Nuclear Society;* **52**: 24-26(1986). (CONF-860610—Summs.).

From American Nuclear Society annual meeting; Reno, NV, USA (15 Jun 1986).

Mixed wastes containing source, special nuclear, or by-product materials as defined by the Atomic Energy Act of 1954, as amended, are not considered as hazardous or solid waste under RCRA and are therefore not addressed specifically under 40CFR260 et. seq. However, radioactive materials are considered under CERCLA. The chemical hazards of mixed wastes are addressed by the US Nuclear Regulatory Commission (NRC), the licenses granted by the States of Washington and South Carolina for existing shallow land burial facilities, and by US Dept. of Transportation (DOT) regulations. The minimum requirements for all classes of waste to protect health and environmental systems is outlined in 10CFR61. The wastes thus disposed must not be capable of deterioration or reaction at normal temperatures or pressures, of explosive reaction with water, or of generating toxic fumes, gases, or vapors. The establishment of a program to ensure that the hazard assessment is performed and that radiological wastes mixed with hazardous wastes comply with the radiological hazard greater than chemical hazard restriction will be needed by each waste generator. The establishment of a mixed waste hazard evaluation program can eliminate the need for secondary waste treatment, which could increase costs or radiological/chemical exposures of the workers. Establishment of these programs for specific facilities would assure compliance with 10CFR61 and the multitude of other regulatory mandates.

42842 **Considerations for treatment methodologies applied to mixed wastes for shallow land disposal.** Ramsey, R.W. Jr. *Transactions of the American Nuclear Society;* **52**: 26-28(1986). (CONF-860610—Summs.).

From American Nuclear Society annual meeting; Reno, NV, USA (15 Jun 1986).

While alternative long-term isolation technologies exist and, have been adopted for some wastes landfilling will continue as the disposal of choice for many chemical and radioactive wastes into the foreseeable future because (a) land is relatively cheap and methods of burial are easily accomplished; (b) some wastes are unsuitable or impractical to emplace in alternative disposal sites, hold in storage or process to achieve decomposition, immobilization, or more secure isolation from the environment; and (c) many small-scale generators of waste cannot justify elaborate pretreatment, volume reduction, immobilization, or more sophisticated alternative disposal to be passed on in the cost of their products. As a possible approach to this problem, techniques must be developed and systems adopted that will provide broadly applicable treatment for wastes prior to emplacement in shallow land disposal facilities. Such treatments must prevent post-emplacement deterioration or interactions resulting in migration of contaminants. They must be deployed in a manner to be cost-effective and used by operations on both large and small scale. Where possible, they should also allow for the recycling or recovery of scarce or potentially limited resources.

42843 **Potential benefits of the recovery of strategic/critical materials from mixed wastes.** Acton, C.F.; Hofman, L.A. (Lawrence Livermore National Lab., CA (USA)). *Transactions of the American Nuclear Society;* **52**: 28(1986). (CONF-860610—Summs.).

From American Nuclear Society annual meeting; Reno, NV, USA (15 Jun 1986).

The United States is currently dependent on foreign suppliers for many of its strategic and critical materials. Chrome, platinum, and manganese are primarily supplied by South Africa and the Soviet Union. Zaire and Zambia are the major sources of cobalt. Budgetary cutbacks over the last 20 yr have reduced the stockpiles maintained for defense use. Many are currently in deficit. Considering the tenuous relationships the United States maintains with many of the countries relied on for these strategic materials, an alternative source of materials would be welcomed. One potential source of some of these strategic and critical materials is uranium mill tailings. Substantial quantities of uranium, vanadium, molybdenum, and cobalt have been successfully recovered from uranium mill tailings at Durango, Old Rifle, Grand Junction, Colorado, and Mexican Hat, Utah. The national defense stockpile currently has a deficit of cobalt and vanadium. Other strategic materials currently in deficit (nickel, platinum, palladium, etc.) also may be recoverable from mill tailings.

42844 **Implications of mixed waste characteristics on shallow land disposal systems and practices.** Duguid, J.O. *Transactions of the American Nuclear Society;* **52**: 28-30(1986). (CONF-860610—Summs.).

From American Nuclear Society annual meeting; Reno, NV, USA (15 Jun 1986).

The single greatest communality among shallow land burial areas is their failure to contain contaminants for more than a few years. Shallow land burial areas depend on the natural soil process, sometimes enhanced by engineering measures such as added clay, to inhibit contaminant migration to air, surface, and/or ground waters. The biogeochemical processes of soils are effective transport inhibitors only if: (1) processes remain intact after waste emplacement; (2) wastes are chemically or biochemically incompatible; and (3) waste/package or waste/package/soil interactions change the chemistry to increase incompatibility with host soils. The implications of mixed waste disposal are impacts on the processes in soil which inhibit or accelerate contaminant migration from trenches or cells. These impacts suggest several approaches that need to be evaluated and selected for implementation on specific waste prior to disposal. These include: (1) thermal destruction of chelating agents; (2) removal of organic carbons; (3) reduction of available anions in wastes, including NO_3 and PO_4; and (4) waste segregation, e.g., metallic waste from decontaminant solutions that have been solidified.

42845 **Long-term site management plan: West Valley LLRW disposal area.** Eng, R.; Hornibrook, C.; Abdelhamid, M.S.; Apoldo, L.J.; Oztunali, O.; Khoury, S.; Cannon, R.; Dehmel, J.C. *Transactions of the American Nuclear Society;* **52**: 33-34(1986). (CONF-860610—Summs.).

From American Nuclear Society annual meeting; Reno, NV, USA (15 Jun 1986).

The low-level radioactive waste (LLRW) disposal area at the Western New York Nuclear Service Center in West Valley (30 miles south of Buffalo) is a former commercial LLRW disposal facility. Disposal operations at the facility stopped in March 1975, shortly after contaminated trench leachate was reported to be seeping through two trench covers. Recently, the Energy Authority and the US Dept. of Energy selected, Envirosphere Company to develop a long-term site management plan for the disposal area. This project supports a series of technical studies required to develop an integrated site management plan ultimately aimed at bringing the disposal areas to the eventual point where passive custoidal care and monitoring activities will be sufficient to protect public health and safety and the environment. The primary objectives of this project are: (1) to formulate and evaluate alternative technical strategies for improved management and eventual stabilization of the disposal area. (2) To design a project to demonstrate the potential effectiveness of the site management plan selected by the Energy Authority for the site. (3) To develop an interim site management plan for use until the long-term site strategy is implemented.

42846 **Characterizing the risk of long-lived radionuclides in waste.** Cohen, J.J.; Smith, C.F.; Toy, A.J. *Transactions of the American Nuclear Society;* **52**: 37(1986). (CONF-860610—Summs.).

From American Nuclear Society annual meeting; Reno, NV, USA (15 Jun 1986).

Concern regarding the hazard of high-level waste (HLW) disposal stems from the fact that many component radionuclides can have extremely long half-lives. Disposal of HLW has been characterized as a 250,000-yr problem (~ 10 x the half-life of ^{239}Pu) and the requirement for its isolation for millennia is viewed as being unique and unprecedented. This perception has resulted in some paradoxical problems. For example, the National Waste Policy Act of 1984 describes HLW as waste that is highly radioactive and requires long term isolation. While it may be reasonable to assume that a requirement for long-term isolation stems from the fact the HLW contains long-lived radionuclides, it is also apparent that any highly radioactive material necessarily cannot have a long half-life. This results from the fact that specific radioactivity is inversely proportional to half-life. The longer its half-life, the less radioactive the material must be. To address such a paradox, it is suggested that simple classification of materials as either radioactive or stable may be inappropriate. Since recent information indicates that

the proton itself may disintegrate with an estimate half-life of 10^{30} yr, literally no isotope can be considered completely stable. To accommodate this phenomenon, cation of materials is suggested. Certain useful insights may be derived from a consideration of waste management problems in the framework of the above classification.

42847 **Can the benefits of nuclear medicine be used to justify low-level waste management risks?.** Lull, R.J. (American College of Nuclear Physicians, Washington, DC (USA)). *Transactions of the American Nuclear Society;* **52**: 38-39(1986). (CONF-860610—Summs.).

From American Nuclear Society annual meeting; Reno, NV, USA (15 Jun 1986).

Risks associated with low-level radioactive waste (LLW) management must not be viewed in isolation, but rather within the context of the societal benefits derived from such activity. Nuclear medicine represents one of the most significant benefits that would disappear should LLW disposal become impossible. This presentation describes the vital role of modern nuclear medicine in clinical diagnosis, therapy, and research. Clear understanding of this valuable role is necessary for rational risk/benefit analysis of the LLW issue.

42848 **Rotation of surface structures during horizontal fault displacements.** Hadjian, A.H. (Bechtel Corp., Los Angeles (USA)). *Transactions of the American Nuclear Society;* **52**: 47-49(1986). (CONF-860610—Summs.).

From American Nuclear Society annual meeting; Reno, NV, USA (15 Jun 1986).

The siting of geologic repositories in seismically active regions may have to consider the potential for minor and/or secondary faults rupturing under certain structures. To understand the behavior of structures during horizontal faulting directly under structures, a simplified static analysis is carried out. Inertial effects during faulting are considered to be minimal and eliminated from further consideration. Faulting could occur at any location and orientation under a structure. The present paper considers only the case when the fault is parallel to and at the center line of the structure.

42849 **Instrument for assaying the radionuclide concentrations in 208-l drums.** Brodzinski, R.L. (Pacific Northwest Lab., Richland, WA (USA)). *Transactions of the American Nuclear Society;* **52**: 52(1986). (CONF-860610—Summs.).

From American Nuclear Society annual meeting; Reno, NV, USA (15 Jun 1986).

The US Nuclear Regulatory Commission's 10CFR61 defines the concentrations of all radionuclides allowable within the various categories of low-level waste. Commercial low-level waste disposal sites can only accept wastes within the legally defined concentration limits and add surcharges to waste shipments having high curie contents. Waste generators must not verify that their waste packages conform to all legal requirements but also must pay disposal costs proportionate to the volume and curie content. An accurate, even through initially more expensive, assay technique may save money in the long run. To provide this accuracy, a portable instrument capable of nondestructively assaying 208-l drums for the concentrations of all radionuclides present has been assembled. The instrument utilizes segmented gamma-ray spectroscopy to determine the concentrations of most fission and activation products and incorporates neutron detectors to determine the concentrations of transuranic nuclides. The system also makes a direct determination of the ^{90}Sr concentration in the drum by a unique method of measuring the bremsstrahlung radiation. All other radioactivities that cannot be measured directly are inferred by correlation factors appropriate to the waste stream represented by the drum. The computer data reduction system can print a shipping manifest that lists all individual, radioisotope concentrations including those required by 10CFR61.

42850 **Technology developments with the potential to significantly improve low-level radioactive waste management.** Jolley, R.L.; Rodgers, B.R. (Oak Ridge National Lab., TN (USA)). *Transactions of the American Nuclear Society;* **52**: 55(1986). (CONF-860610—Summs.).

From American Nuclear Society annual meeting; Reno, NV, USA (15 Jun 1986).

The purpose of this paper is to identify the research and technology development needed to significantly improve current low-level radioactive waste (LLRW) treatment. The task was accomplished as part of a larger program to provide an assessment of currently available technology for treating commercial LLRW, to initiate development of a methodology for choosing one technology over another for a given application, and to identify research needed to improve treatment techniques and decision methodology.

42851 **WVNS experiences in the detection, monitoring, and leakage from underground tanks containing contaminated kerosene/TBP.** Valenti, P.J.; McVay, C.W.; Bourgeois, P. *Transactions of the American Nuclear Society;* **52**: 55-56(1986). (CONF-860610—Summs.).

From American Nuclear Society annual meeting; Reno, NV, USA (15 Jun 1986).

Tanks of radioactively contaminated kerosene/tributyl phosphate (TBP) disposed of at West Valley in 1969, when the plant was being utilized to reprocess commercial nuclear fuel, were determined to be leaking. Contaminated kerosene/TBP was initially detected in November 1983 when samples taken from US Geological Survey monitor wells tested positively for both radioactive and organic constituents. An extensive monitoring, sampling, and analysis program, which involved the installation of ~ 100 monitor points, core bores, and scavenger wells, has been in effect since November 1983 when the migrating kerosene/TBP was initially discovered. Sample analysis has served to provide data on the radionuclide concentration as the kerosene/TBP migrates through the soil. Recent acquisition of a portable gas chromatograph is expected to yield even more definitive information on migration rates. Removal of organics from the scavenger wells will continue while more permanent control measures are finalized. The current efforts will involve the installation of a support structure, erection of a light-weight reusable weather shelter, excavation and potential removal of the tanks and contents, as well as packaging and/or otherwise stabilizing of the resulting waste. The significance of this project is that it will provide a data base for future work in former radioactive disposal sites. A discussion of the monitoring, sampling, and analysis is provided in conjunction with the stabilization efforts.

42852 **Systems analysis of a leaching model for low-level waste.** Cox, N.D. (EG & G Idaho, Inc., Idaho Falls (USA)). *Transactions of the American Nuclear Society;* **52**: 56(1986). (CONF-860610—Summs.).

From American Nuclear Society annual meeting; Reno, NV, USA (15 Jun 1986).

The interactive effects among various parameters pertaining to shallow-land burial of low-level waste are not entirely elucidated in the literature. For example, it is often stated that volume reduction may reduce shipping costs if the resulting volumetric activity of the waste is limited sufficiently. There is another effect of volume reduction that is not so obvious, as is shown in this paper. While testing a performance-predicting computer program, an apparently anomalous result was observed. To investigate this anomaly and also interactions among other variables, an unsophisticated mathematical model, focusing on the leach phenomenon, was derived in order to provide a vehicle for a systems analysis of the burial zone.

42853 **Determination of optimum alternative LLRW disposal site/disposal technology combinations.** Voth, M.H.; Witzig, W.F. (Pennsylvania State Univ., University Park (USA)). *Transactions of the American Nuclear Society;* **52**: 57(1986). (CONF-860610—Summs.).

From American Nuclear Society annual meeting; Reno, NV, USA (15 Jun 1986).

As individual states and regional compacts of states implement the Low-Level Radioactive Waste (LLRW) Policy Act of 1980, they must select both a disposal site and disposal technology. The impacts to be considered on the health and safety of the general public include radiological and nonradiological effects. Economics are included in that excessive disposal costs deprive the public of alternative personal expenditures. A figure-of-merit methodology is developed to assist in identifying the disposal site and technology having the least overall impact. The figure of merit begins with a

nominal positive value selected to represent the societal benefits derived from operations that result in the generation of radioactive waste. An incremental adjustment, either positive or negative, is made to the figure of merit for each impact considered. An economic basis provides a common denominator between impacts and the figure of merit.

42854 **Investigations on the use of an agglomerating agent for radioactively contaminated soils.** Anno, J.N.; Christenson, J.M.; Klein, A.C.; Rieser, L.A. *Transactions of the American Nuclear Society;* **52**: 76-77(1986). (CONF-860610—Summs.).

From American Nuclear Society annual meeting; Reno, NV, USA (15 Jun 1986).

In this paper, the authors report on the results of an investigation of the feasibility of in situ use of a commercially available agglomerating agent (Resinex 60) to treat radioactively contaminated soils so that they will meet Waste Isolation Pilot Project (WIPP) particle size criterion for transportation and retrievable storage. The treatment process involves the wetting of the soil with an emulsion of submicron resin particles in an aqueous carrier. The carrier penetrates the soil and then evaporates leaving the finer particles bound in large agglomerates. The investigation examined a variety of treatment methods to determine an optimum technique for meeting the WIPP particle size criterion for transportation and disposal ($<$ 1% by weight of $<$ 10-μm particles and $<$ 15% by weight of $<$ 200-μm particles).

42855 **Flow of ground water around buried waste.** Chambre, P.L.; Kang, C.H.; Pigford, T.H. (Univ. of California, Berkeley (USA)). *Transactions of the American Nuclear Society;* **52**: 77-78(1986). (CONF-860610—Summs.).

From American Nuclear Society annual meeting; Reno, NV, USA (15 Jun 1986).

Analyses by Chambre and Andersson et al. of the mass transfer of radionuclides from waste packages into surrounding backfill and rock have considered diffusive-convective transport of dissolved species in ground water in the rock but have assumed no flow of ground water through the backfill. Although in some geologic repositories the ground water flow is expected to be so small that radionuclide release is controlled by molecular diffusion, to assess the possible contribution of backfill water flow to radionuclide release it is necessary to analyze the local flow field in layers of backfill and rock surrounding a waste package. Here the authors illustrate some results from a potential-flow theory developed by Chambre to predict the steady flow stream lines, equipotential contours, and flow velocities in backfill and porous rock surrounding a spherical or cylindrical waste package.

42856 **Mass transfer of a radioactive decay chain through backfill.** Chambre, P.L.; Lung, H.C.; Pigford, T.H. (Univ. of California, Berkeley (USA)). *Transactions of the American Nuclear Society;* **52**: 78-80(1986). (CONF-860610—Summs.).

From American Nuclear Society annual meeting; Reno, NV, USA (15 Jun 1986).

Backfill serves in a nuclear waste package as an engineered barrier to delay the release of radionuclides to surrounding media. Previous studies provided some analytical methods to predict the backfill performance. None of these studies, however, considered a radioactive decay chain, and some of them even neglected decay and assumed an infinite extent of backfill. The authors now present a model to remedy these shortcomings so that a more thorough analysis is available.

42857 **Mass-transfer-limited release of a soluble waste species.** Kim, C.L.; Chambre, P.L.; Pigford, T.H. (Univ. of California, Berkeley (USA)). *Transactions of the American Nuclear Society;* **52**: 80-82(1986). (CONF-860610—Summs.).

From American Nuclear Society annual meeting; Reno, NV, USA (15 Jun 1986).

The authors have earlier presented analytical solutions for the rates of dissolution of solubility-limited species from solid waste imbedded in saturated porous rock. The dissolution rate of some species, however, may not be limited by solubility of the species or of the waste matrix. For example, the portion of the fission product cesium and iodine in spent fuel that exists in the fuel/cladding gap and in voids and grain boundaries is available for rapid dissolution if exposed to ground water. Even though dissolution may be rapid, the rate of release of these soluble species from the waste package will be limited by the rate of mass transfer of the dissolved species through the surrounding porous media. Here the authors present the results of a new mass transfer analysis of the time-dependent release rate of species that can dissolve rapidly from the gap activity and more slowly from the waste matrix, as limited by molecular diffusion into surrounding porous rock.

42858 **Hanford defense waste environmental impact statement.** Burnham, J.B.; Nelson, I.C.; White, J.D. (Pacific Northwest Lab., Richland, WA (USA)). *Transactions of the American Nuclear Society;* **52**: 86-88(1986). (CONF-860610—Summs.).

From American Nuclear Society annual meeting; Reno, NV, USA (15 Jun 1986).

The environmental impacts of three alternative methods for disposal of Hanford defense wastes were analyzed in an environmental impact statement (EIS), DOE/EIS-0013. A fourth alternative, no disposal action, was included to satisfy CEQ regulations. Hanford defense waste differ dramatically from commercial nuclear wastes. The fuel elements are irradiated to very low burnups (by commercial standards), the fuel has all been processed (in some cases several times) to extract uranium and plutonium, much of the strontium and cesium has been removed and concentrated in capsules, and the remaining wastes have been highly diluted by processing and by neutralizing salts. The activity per unit volume is ~ 1/1000 that of commercial spent fuel. Hanford waste is currently stored in a variety of forms and locations. It was categorized into six classes for analysis. The major radionuclides by waste class are shown. Numerous alternatives were considered for treating Hanford defense wastes. Of those studied, four were considered to be reasonable for detailed analysis. A highly abbreviated description of their salient features is presented: (1) geologic disposal; (2) in-place stabilization and disposal; (3) reference (combination disposal); and (4) no disposal action.

42859 **Hanford waste management plan.** Bracken, E.A.; Bergman, T.B. (Dept. of Energy, Richland, WA (USA)). *Transactions of the American Nuclear Society;* **52**: 88-89(1986). (CONF-860610—Summs.).

From American Nuclear Society annual meeting; Reno, NV, USA (15 Jun 1986).

A significant challenge facing the US Dept. of Energy in the near future is that of effectively beginning the disposal of radioactive wastes accumulated since the nuclear program began in the early 1940s. This paper provides an overview of the approach being evaluated for defense waste at the Hanford Site near Richland, Washington, where over 60% of US defense waste is stored.

42860 **Development of acceptance criteria for near-surface disposal of Hanford Defense Waste.** Wood, D.E.; Huizenga, D.G.; Napier, B.A. *Transactions of the American Nuclear Society;* **52**: 89-90(1986). (CONF-860610—Summs.).

From American Nuclear Society annual meeting; Reno, NV, USA (15 Jun 1986).

The US Dept. of Energy (DOE) is developing specific plans for disposal of Hanford defense waste (HDW). The impacts of alternatives ranging from retrieving all of the transuranic (TRU) and high-level waste (HLW) to disposing of it all near-surface are noted. Even if the waste is retrieved, it will be subject to sorting and additional nuclide partitioning, such that the low-activity fraction may be disposed of near-surface as low-level waste (LLW). Thus, it is necessary to develop acceptance criteria for whatever portion of the waste is determined to be qualified for near-surface disposal, based on decisions resulting from the HDW environmental impact statement. This paper discusses the background and status of criteria development, and gives some of the early results and insights gained from the program.

42861 **Disposal of wastes in Hanford single-shell tanks.** Adams, M.R.; Flyckt, D.L.; McBeath, R.S. *Transactions of the American Nuclear Society;* **52**: 90(1986). (CONF-860610—Summs.).

From American Nuclear Society annual meeting; Reno, NV, USA (15 Jun 1986).

Wastes stored in single-shell tanks are among radioactive waste located at the US Dept. of Energy's Hanford site. The draft Hanford defense waste environmental impact statement evaluates alternatives for final disposal of these wastes. These alternatives include geologic disposal, continued storage (not a final disposal option), in place-stabilization and disposal, and a reference alternative (combination disposal). In the case of single-shell tank wastes, both the in-place stabilization and disposal and reference options would lead to the wastes being disposed of in place. The geologic disposal alternative would lead to retrieval and processing of the wastes. The technology required for implementation of in-place stabilization and disposal of single-shell tank wastes is being developed pending possible selection of this option. The inplace stabilization technology includes dome fill, barrier, and marker placement. Based on the minimal transuranic content, heat loading, waste inventory, and chemical content, the TY tank farm has been selected for a test of this technology.

42862 **Preparation of complexes concentrate waste for near-surface disposal.** Schulz, W.W.; Kurath, D.E. *Transactions of the American Nuclear Society;* **52**: 91-92(1986). (CONF-860610—Summs.).

From American Nuclear Society annual meeting; Reno, NV, USA (15 Jun 1986).

Approximately 9100 m^3 (2.4 x 10^6 gal of so-called complexed concentrate (CC) waste is currently stored in several double-shell tanks at the US Dept. of Energy Hanford site. This waste contains large concentrations (total organic carbon = 0.039 kg x l^{-1}) of various complexing agents such as ethylenediamine-tetraacetic acid and citric acid; it is also a transuranic (TRU)-type waste (i.e., contains > 3.7 x 10^6 Bq x kg^{-1} of TRU elements). The CC waste was generated during previous (1967-1980) operation of a bis-2-ethylhexylphosphoric acid solvent extraction process to remove ^{90}Sr from aged PUREX process waste. Engineering analyses establish convincingly that direct disposal (i.e., without any pretreatment) of CC either as a grout form in near-surface facilities or as a vitrified form in a geologic repository is not desirable. Cost-effective pretreatment procedures that overcome the regulatory concerns are essential to final disposal of CC. Two fundamentally different approaches to pretreatment of CC are being considered: (1) removal of TRU radionuclides - via the TRUEX (TRansUranium EXtraction) process - from acidified CC without concomitant destruction of organic complexants. (2) Simultaneous destruction of organic compounds and precipitation of TRU elements from alkaline CC.

42863 **Hanford transportable grout facility: technology and design.** Williamson, G.F.; Treat, R.L.; McDaniel, E.W. *Transactions of the American Nuclear Society;* **52**: 92-93(1986). (CONF-860610—Summs.).

From American Nuclear Society annual meeting; Reno, NV, USA (15 Jun 1986).

Grouting of selected low-level liquid waste (LLW) is a key part of the overall management strategy developed for disposal of some Hanford site wastes. Cement-based grouts will be utilized to immobilize LLW generated from a variety of sources. It is expected that up to 415,000 m^3 (10^6 gal) of grout may be produced over the next 25 yr. The mixing of LLW with cementitious materials to form grout will make valuable double-shell tank storage space available for other wastes, reduce the construction of new double-shell tanks, and dispose of waste in an environmentally safe manner. Specific grout formulations are being developed by Oak Ridge National Laboratory, tailored for each category of Hanford LLW. Bulk powdered materials will be blended to produce a homogeneous dry mix. Grout formulations are developed to maximize the waste loading using commercially available, low-cost raw materials. The grout production facilities will consist of several major systems the Dry Materials Receiving and Handling Facility (DMRHF), a one-million-gal liquid feed tank, the transportable grout equipment (TGE), and the disposal system. These facilities can be operated safely and within US Dept. of Energy orders and standards.

0530 Environmental Aspects

REFER ALSO TO CITATION(S) 42725, 42752, 42753, 42754, 42755, 42756, 42757, 42758, 42759, 42760, 42761, 42762, 42763, 42774, 42777, 42778, 42779, 42780, 42782, 42783, 42793, 42796, 42814, 42830, 42831, 42832, 42833, 42836, 42839, 42868, 43864, 43958

42864 **(DPSPU—88-30-1-Vol.2) Savannah River Plant environmental report. Annual report for 1987.** Mikol, S.C.; Burckhalter, L.T.; Todd, J.L.; Martin, D.K. (Du Pont de Nemours (E.I.) and Co., Aiken, SC (USA). Savannah River Lab.). 1987. Contract AC09-76SR00001. 512p. NTIS, PC A 22; 3; GPO Dep. Order Number DE88012424/JAW.

This volume of Savannah River Plant Environmental Report for 1987 (DPSPU 88-30-1) contains the figures and tables referenced in Volume 1. The figures contain graphic illustrations of sample locations and/or data. The tables contain summaries of the following types of data: Federal and State standards and guides applicable to SRP operations; concentrations of radioactivity in environmental media; the quantity of radioactivity released to the environment from SRP operations; off site radiation dose commitments from SRP operations; measurements of physical properties, chemicals and metals concentrations in environmental media; and interlaboratory comparison of analytical results. The figures and tables in this report contain information about the routine environmental monitoring program at SRP unless otherwise indicated. No attempt has been made to include all data from environmental research programs. Variations in content from year to year reflect changes in the routine environmental monitoring program or the inability to obtain samples from a specific location.

42865 **(SKB-TR—87-23) Radionuclide co-precipitation.** Bruno, J.; Sandino, A. (Swedish Nuclear Fuel and Waste Management Co., Stockholm). Dec 1987. 24p. NTIS (US Sales Only), PC A03/MF A01. Order Number DE88754187/JAW.

The thermodynamic and kinetic behaviour of the minor components of the spent fuel matrix has been theoretically and experimentally investigated. Two different situations have been studied: Part I, the near field scenario, where the release and migration of the minor components is dependent on the solubility behaviour of UO/sub 2/(s); Part II, the far field, where the solubility and transport of the radionuclides is related to the major geochemical processes occurring.

42866 **Method for monitoring stack gases for uranium activity.** Beverly, C.R.; Ernstberger, H.G. (to Dept. of Energy, Washington, DC). US Patent 4,742,009. 3 May 1988. Filed date 3 Jul 1985. vp. Patent and Trademark Office, Box 9, Washington, DC 20232.

A method for sampling stack gases emanating from the purge cascade of a gaseous diffusion cascade system utilized to enrich uranium for determining the presence and extent of uranium in the stack gases in the form of gaseous uranium hexafluoride, is described comprising the steps of removing a side stream of gases from the stack gases, contacting the side stream of the stack gases with a stream of air sufficiently saturated with moisture for reacting with and converting any gaseous uranium hexafluroide contracted thereby in the side stream of stack gases to particulate uranyl fluoride. Thereafter contacting the side stream of stack gases containing the particulate uranyl fluoride with moving filter means for continuously intercepting and conveying the intercepted particulate uranyl fluoride away from the side stream of stack gases, and continually scanning the moving filter means with radiation monitoring means for sensing the presence and extent of particulate uranyl fluoride on the moving filter means which is indicative of the extent of particulate uranyl fluoride in the side stream of stack gases which in turn is indicative of the presence and extent of uranium hexafluoride in the stack gases.

0540 Health And Safety

REFER ALSO TO CITATION(S) 42741, 42776, 42789, 42790, 42791, 42792, 42793, 43232, 43243, 43627, 43958

42867 (CONF-871075—Vol.1-Pt.3, pp 425-427) **Field analytics, a faster way to the answer.** Hansen, E.M. (Roy F. Weston, Inc. (USA)). 1987. NTIS, PC A18/MF A01. Order Number DE88007805/JAW.

From 3. Oak Ridge model conference on waste problems; Oak Ridge, TN, USA (13 Oct 1987).

Analytical requirements are a significant component of site assessments and cleanups due to the need for larger data bases to define the extent of contamination. This increased data requirement typically increases the samples required to provide the information necessary to characterize a site. The technical complexity and extensive quality control requirements for current analytical protocols and associated reporting requirements can result in significant cost increases and possibly extend RI/FS and cleanup completion schedules due to typical 4-8 week analytical turnaround time. The growing requirement for validation of analytical data used to select appropriate remedial action alternatives and/or declare a site clean, adds to the complexity of this issue. This presentation separates the myths and realities of field analyses, summarizes a variety of field analytical methods, and describes WESTON's experience in the development, validation and use of several methods.

42868 **(PNL—6555) Estimating calibration equations for predicting Ra-226 soil concentrations using RTRAK in-situ detectors at the Ambrosia Lake, New Mexico, Umtra site.** Gilbert, R. O.; Meyer, H. R.; Miller, M. L.; Begley, C. (Pacific Northwest Lab., Richland, WA (USA)). Jun 1988. Contract AC06-76RL01830. 32p. NTIS, PC A03/MF A01; 1; GPO Dep. Order Number DE88012510/JAW.

This report describes a field study conducted at the Ambrosia Lake, New Mexico, UMTRA site to obtain data for calibrating the RTRAK Sodium Iodide (NaI) detectors for estimating concentrations of Ra-226 in surface soil. The statistical analyses indicate that the data are useful for estimating the calibration equations. Several statistical models are used to evaluate which model is best as a basis for the calibration equations. A procedure is provided for using the estimated calibration equations and extensive RTRAK measurements to estimate the average Ra-226 concentration on 100-m^2 land areas to determine whether additional remedial action is needed. The UMTRA Project office proposes to use the RTRAK for cleanup verification of surface Ra-226 contamination. The system enables 100% coverage of areas having undergone remedial action. The sensitivity of the system enables verification at less than 5 pCi/g averaged over 100 m^2, as specified by the Environmental Protection Agency (EPA) standards (40 CFR Part 192). This analysis demonstrates RTRAK's ability to meet reasonable standards of statistical accuracy, using commonly accepted procedures. 5 refs., 8 figs., 1 tab.

42869 **(VROM-DSB—87-29) Risks of transport of radioactive materials on the road; some exploring calculations performed with the INTERTRAN-model.** (Ministerie van Volkshuisvesting, Ruimtelijke Ordening en Milieubeheer, The Hague (Netherlands). Directie Stralenbescherming). Apr 1987. 38p. (In Dutch). (VROM—70284/4-87). NTIS (US Sales Only), PC A03/MF A01. Order Number DE88701781/JAW.

Under the auspices of the IAEA a computercode, named INTERTRAN, has been developed in order to calculate the risks of the transport of radioactive materials. This code has to be tested nearer. For the Dutch situation a number of calculations has been performed of more or less realistic cases in which four transport streams have been investigated. Two transport routes are chosen. The risks thus obtained are compared quantitatively with the risks of LPG-transports. 4 refs.; 9 figs.

42870 **Decontamination and decommissioning of the West Valley reprocessing plant.** Daugherty, H.F.; Keel, R. *Transactions of the American Nuclear Society;* **52**: 34-35(1986). (CONF-860610—Summs.).

From American Nuclear Society annual meeting; Reno, NV, USA (15 Jun 1986).

This paper addresses the methods being used to decontaminate and decommission the various cells and operating spaces of the former West Valley Fuel Reprocessing Facility, located in West Valley, New York. Topics addressed include the application of innovative techniques to permit decontamination and decommissioning (D & D) of processing cells with initial radiological conditions including radiation levels > 100 R/h and extremely high levels of both alpha and beta/gamma airborne concentrations exceeding 10,000 times the maximum permissible concentration.

0550 Safeguards, Inspection, And Accountability

REFER ALSO TO CITATION(S) 42773

42871 **(DOE/RL—88-02) Defense decontamination and decommissioning (D & D) program overview.** (Department of Energy, Richland, WA (USA). Richland Operations Office). 1 Jan 1988. Contract AC06-87RL10930. 48p. NTIS, PC A03/MF A01; 1; GPO Dep. Order Number DE88012348/JAW.

The Defense D&D Program currently has an inventory of 218 favilities located at seven sites across the United States. Inclued are shutdown nuclear reactors, chemical processing plants, waste storage and treatment systems, laboratories, and support facilities. Criteria have been established to accept other radioactively contaminated facilities into the program if they were used for DOE sponsored defense activities, are surplus to DOE needs and have no current program sponsor.

42872 **(IAEA-INFCIRC—346) Telex messages to the Director General from the President of the Atomic Energy Organization of Iran.** (International Atomic Energy Agency, Vienna (Austria)). Nov 1987. 4p. NTIS (US Sales Only), PC A02/MF A01. Order Number DE88701731/JAW.

The document includes three telex messages dated 17 November 1987 to the Director General of the IAEA from the President of the Atomic Energy Organization of Iran in connection with the Iraqi military attack of the Bushehr Nuclear Power Plant on 17 November 1987.

42873 **(IAEA-INFCIRC—346-Add.1) Telex messages to the Director General from the President of the Atomic Energy Organization of Iran.** (International Atomic Energy Agency, Vienna (Austria)). Nov 1987. 2p. NTIS (US Sales Only), PC A02/MF A01. Order Number DE88701732/JAW.

The document reproduces the text of a letter dated 18 November 1987 from the Director General of the IAEA to the Resident Representative of the Islamic Republic of Iran written in response to telexes from the President of the Atomic Energy Organization of Iran (INFCIRC/346) referring to the Iraqi military attack of the Bushehr Nuclear Power Plant on 17 November 1987.

42874 **(IAEA-INFCIRC—346-Add.2) Telex messages to the Director General from the President of the Atomic Energy Organization of Iran.** (International Atomic Energy Agency, Vienna (Austria)). Nov 1987. 4p. NTIS (US Sales Only), PC A02/MF A01. Order Number DE88701733/JAW.

The document reproduces the text of a telex dated 19 November 1987 from the President of the Atomic Energy Organization of Iran to the Director General of the IAEA and the text of a telex dated 24 November 1987 from the Director General to the President of the Atomic Energy Organization of Iran in connection with the Iraqi military attack of the Bushehr Nuclear Power Plant.

42875 **(IAEA-INFCIRC—346-Add.3) Telex messages to the Director General from the President of the Atomic Energy Organization of Iran.** (International Atomic Energy Agency, Vienna (Austria)). Nov 1987. 4p. NTIS (US Sales Only), PC A02/MF A01. Order Number DE88701734/JAW.

The document reproduces the text of a telex dated 26 November 1987 from the President of the Atomic Energy Organization of Iran to the Director General of the IAEA and the Director General's reply, dated 27 November 1987, in connection with the Iraqi military attack of the Bushehr Nuclear Power Plant.

42876 **(IAEA-INFCIRC—347) Exchange of letters between the Resident Representative of Mexico and the Director General.** (International Atomic Energy Agency, Vienna (Austria)). Nov 1987. 3p. NTIS (US Sales Only), PC A02/MF A01. Order Number DE88701735/JAW.

Hard copies are available in English and Spanish from IAEA Division of Publications, Distribution Unit.

The document reproduces the text of a letter (dated 23 November 1987) to the Director General of the IAEA from the Resident Representative of Mexico and the Director General's reply (dated 24 November 1987) in connection with the military attack of the Bushehr Nuclear Power Plant.

42877 **(SAND—88-1279C) SAVI: a pc-based vulnerability assessment program.** Matter, J.C. (Sandia National Labs., Albuquerque, NM (USA)). 1988. Contract AC04-76DP00789. 9p. (CONF-8806157—1). NTIS, PC A02/MF A01; 1; GPO Dep. Order Number DE88011915/JAW.

From Security technology symposium; Virginia Beach, VA, USA (8 Jun 1988).

SAVI (Systematic Analysis of Vulnerability to Intrusion) represents a new generation of analyses programs, which assess the vulnerability of a physical protection system and are designed for use on personal computers. Features unique to SAVI include (a) analysis of all adversary paths, (b) a safeguards-component catalog with a detection/delay performance database, (c) results in graphic form, and (d) path-upgrade recommendations. The primary figure of merit calculated for system effectiveness is the probability of adversary interruption before mission completion. SAVI has been taught to more than 200 security analysts from the US Dept. of Energy and is currently its standard tool for outsider-threat vulnerability analysis.

42878 **(SAND—88-1448C) Demonstration personnel and material tracking system at ANL-W.** Roybal, J.A.; Ortiz, S.; Henslee, S.P. (Sandia National Labs., Albuquerque, NM (USA); Argonne National Lab., Idaho Falls, ID (USA)). 1988. Contract AC04-76DP00789. 10p. (CONF-880631—13). NTIS, PC A02/MF A01; 1; GPO Dep. Order Number DE88012339/JAW.

From 29. annual meeting of the Institute of Nuclear Materials Management; Las Vegas, NV, USA (26 Jun 1988).

A Personnel and Material Tracking System (PMTS) was demonstrated in the Fuel Manufacturing Facility (FMF) at Argonne National Laboratories-West (ANL-W) in July, 1987. The PMTS is intended to aid in the transfer of inventory materials from area to area within a facility such as FMF. It is also intended to assure that only those personnel who are authorized to do so may conduct these transfer operations. The PMTS Personnel Movement (PM) subsystem uses portals installed between areas to alert the system to the movement of personnel between areas. The portals are composed to two sensors, one on either side of a proximity badge reader, to detect the presence of personnel entering the portal area. However, a restricted area can be assigned to any badge holder which will cause the system to issue an alert if the badge holder passes into his/her restricted area. The PM subsystem is intended to be transparent when in use. The PMTS Inventory Material Access (IMA) subsystem provides two functions: material control and material access. The material control is provided by the Wireless Alarm Transmission of Container Handling (WATCH) system which is a sensor rf transmitter system that detects item movements. Material access is provided by the Mobile Accountability Verification Inventory Station (MAVIS) system which is a self-powered smart barcode reader.

42879 **(SAND—88-1670C) Evaluation of a real-time personnel and material tracking system.** Trujillo, A.A.; Hoover, C.E.; Garcia, B.A. (Sandia National Labs., Albuquerque, NM (USA)). 1988. Contract AC04-76DP00789. 7p. (CONF-880631—14). NTIS, PC A02/MF A01; 1; GPO Dep. Order Number DE88012335/JAW.

From 29. annual meeting of the Institute of Nuclear Materials Management; Las Vegas, NV, USA (26 Jun 1988).

Past experience in addressing the insider threat has led to the development of general principles for mitigating the insider threat while minimizing adverse impacts on site operations. Among the general principles developed was the requirement for a real-time personnel and material tracking system. A real-time system for personnel and material tracking will aid in mitigating the insider threat by providing critical information regarding the movement and location of personnel and material. In addition, this system can provide an early detection mechanism for potential insider actions. A system integrating Radio Frequency (RF) transmitters for real-time personnel and material tracking has been developed. This system was installed and tested in an operational environment. This test was intended to demonstrate the system's ability to successfully control access to material and areas by personnel, as well as providing information regarding the status of materials in transit and storage.

42880 **(SAND—88-1778C) Testing of a low-cost item monitoring system.** Frank, D.J.; Cunningham, K.R.; Hoover, C.E.; Trujillo, A.A. (Rockwell International Corp., Golden, CO (USA). Rocky Flats Plant; Sandia National Labs., Albuquerque, NM (USA)). 1988. Contract AC04-76DP00789. 4p. (CONF-880631—12). NTIS, PC A02/MF A01; 1; GPO Dep. Order Number DE88012328/JAW.

From 29. annual meeting of the Institute of Nuclear Materials Management; Las Vegas, NV, USA (26 Jun 1988).

Material control is an important element of any security system which seeks to address the insider threat. Sandia has developed Wireless Alarm Transmission of Container Handling (WATCH) which is a remote sensor system that provides a low-cost, convenient way of monitoring item movement. Rockwell International/Rocky Flats Plant (RFP) and Sandia have conducted a long-term evaluation of the WATCH system in an operating production facility. Testing was conducted in a large scale, remote access storage vault for Special Nuclear Materials (SNM). A total of fourteen WATCH units were placed on storage containers in the vault. A schedule was established which provided prearranged movement of monitored containers on a regular basis. The test objectives were to determine (1) the feasibility of using the WATCH system technology to implement material control concepts, (2) the system performance in an active production area, and high radiation environment, (3) the sensitivity settings required for optimum system performance, and (4) the spatial resolution of the transmitter/receiver utilized.

0560 Legislation And Regulations

REFER ALSO TO CITATION(S) 42776, 42794, 43285

07 ISOTOPE AND RADIATION SOURCE TECHNOLOGY

0701 Physical Isotope Separation

42881 **(CEA-CONF—9292) Isotope separation by ionic cyclotron resonance.** Louvet, P. (CEA Centre d'Etudes Nucleaires de Saclay, 91 - Gif-sur-Yvette (France). Dept. de Physico-Chimie). 1987. 25p. (CONF-870782—). NTIS (US Sales Only), PC A03/MF A01. Order Number DE88753912/JAW.

From Workshop on separation phenomena in liquids and gases; Darmstadt, F.R. Germany (20 Jul 1987).

The principle of the process of isotopic separation by ionic cyclotron resonance is reviewed succinctly. Afterwards, the main parts of the demonstration device which is in operation at the CEA, are described here: the superconducting magnetic field, the used diagnostics, the principle of the source and the collecting apparatus. The theoretical calculations presented here included a multi-fluid flow model of the plasma source ionic components and the theoretical calculation of the isotopic effect. This effect is given as functions of the electric and magnetic fields in the frame of

single particle approximation and of plasma collective theory. Some experimental results for chromium are compared to the computations. The application of the process to ponderal separation of metal isotopes, as Chromium, Nickel, Molybdenum... is discussed in view of production of medical, structural and irradiation isotopes.

42882 **(INIS-BR—1013) Radioisotope production.** Silva, C.P.G. da. (Instituto de Pesquisas Energeticas e Nucleares, Sao Paulo (Brazil)). 1987. 9p. (In Portuguese). (CONF-8707179—). NTIS (US Sales Only), PC A02/MF A01. Order Number DE88702597/JAW.

From Latin American course on the socio-economical benefits of nuclear energy; Rio de Janeiro, Brazil (27 Jul 1987).

The types of nuclear reactions for radioisotope production using nuclear reactors and cyclotrons are described. The question of purity and quality control of the products are discussed. (M.C.K.).

0702 Radiation Sources

42883 **(INIS-BR—1005) Final report of aerial surveying team of the Goiania City, Brazil.** Barreto, P.M.C.; Simoes, E. (Instituto de Radioprotecao e Dosimetria, Rio de Janeiro (Brazil)). Oct 1987. 14p. (In Portuguese). NTIS (US Sales Only), PC A03/MF A01. Order Number DE88702589/JAW.

The results of the aeroradiometric survey using an helicopter, in Goiania City, Brazil, to localize focus of radioactive contamination due an accidental rupture of a capsule of Cs-137 source, are presented. The system of radiometric measurements consisted of two portable gamma spectrometers, two NaI(Tl) detectors and a graphic register. (M.C.K.).

08 Production

REFER ALSO TO CITATION(S) 43341

09 OTHER SYNTHETIC AND NATURAL FUELS

0902 Alcohol Fuels

42884 **(Juel—2168) Fermenation of xylose with the thermophilic bacterium Thermoanaerobacter finnii.** Schmid, U. (Kernforschungsanlage Juelich G.m.b.H. (Germany, F.R.). Inst. fuer Biotechnologie; Duesseldorf Univ. (Germany, F.R.)). Dec 1987. 139p. (In German). NTIS (US Sales Only), PC A07/MF A01. Order Number DE88753780/JAW.

This study presents results of the fermentation of xylose with the thermophilic bacterium Thermoanaerobacter finnii, especially the effects of substrate concentration on end product formation. Fermentation of xylose yields ethanol, acetate, L-lactate, H/sub 2/ and CO/sub 2/ in varying amounts depending on the substrate concentration. Batch fermentations with increasing xylose concentrations higher than 66 mM resulted in a decrease of the ethanol yield from 1.25 to 0.85 mol/mol xylose (maximum ethanol yield is 1.66 mol/mol xylose) and in an increase in lactate formation. Fed-batch-fermentations with stationary concentrations of xylose between 20 and 60 mM lead to a very low lactate production (2 mM), so that from 200 mM of xylose 230 mM ethanol were produced, corresponding to 70% of the maximal achievable yield. Increasing xylose consumption rates lead to increasing lactate formation rates (from 0.04 to 1.52 mmol/l x h), whereas the ethanol formation rate remained largely constant (5.2 and 4.6 mmol/l x h respectively). The inhibitory effect of ethanol on growth and product formation was circumvented by continuous removal of the produced alcohol from the culture broth by an inert gas stream. That way xylose consumption could be raised from 200 to 400 mM. (orig./EF)

42885 **(NP—8770529) Screening of yeasts associated with food from the Sudan and their possible application for single cell protein and ethanol production.** Hamad, S.H. (Technische Univ. Berlin (Germany, F.R.). Fachbereich Lebensmitteltechnologie und Biotechnologie). 18 Jun 1986. 165p. NTIS (US Sales Only), PC A08/MF A01. Order Number DE88770259/JAW.

In a screening program carried out in the Sudan, 200 pure yeast cultures were isolated and analysed. In a series of fermentations the kinetic parameters and the chemical composition of C.Kefyr were tested. The kinetic parameters identified for C. Kefyr in a bioreactor with 10 l working volume were used to simulate a fed batch cultivation in a 30 m/sup 3/ bioreactor with different values for the volumetric mass transfer coefficient of oxygen. Heat production and oxygen requirement were under the critical values calculated throughout the simulation. The ability of C. Kefyr to produce and tolerate ethanol at different fermentation temperatures was tested in shake flasks experiments. These experiments showed that C. Kefyr can produce and tolerate up to 10% V/V ethanol at the fermentation temperature of 40/sup 0/C. (MBC)

42886 (NUSE—8701, pp 135-142) **Germanium methoxide. New reagent for controlling the pore-opening size of zeolite by CVD.** Niwa, Miki; Hidalgo, C.V.; Hattori, Tadashi; Murakami, Yuichi. (Nagoya Univ., Faculty of Engineering, Nagoya, Japan). Feb 1987. Nago Univ., Nagoya, Japan.

In FY 1985 Report of Nagoya Univ., Research Center for Resource and Energy Conservation.

Because of high reactivity with the zeolite surface, CVD temperature had to be lowered to 423 - 333 °K to obtain the homogeneously-modified zeolite. Deposition of germanium oxide on the external surface was confirmed by ESCA measurements, and the conservation of the internal acidity was checked by TPD (Temperature Programmed Desorption) of ammonia. Sorption experiments using hexane or p-xylene as adsorbent indicated that the pore-opening size was gradually decreased according to the desorption extent. An analysis on the basis of the sorption kinetics, however, revealed that the pore-opening size was controlled uniformly and precisely at 333 °K of CVD temperature, was rather heterogeniously controlled at 423 °K. Thus it was found that the rate of desorption had to be decreased to obtain the uniformly deposited surface layer of germanium oxide. Extremely high shape-selectivity of cracking of octane isomers was observed on the germanium-deposited H-mordenite. (10 figs, 1 tab, 8 refs)

42887 (NUSE—8701, pp 130-134) **Fine control of the pore-opening size of zeolite ZSM-5 by chemical vapor deposition of silicon methoxide.** Niwa, Miki; Kato, Masaki; Hattori, Tadashi; Murakami, Yuichi. (Nagoya Univ., Faculty of Engineering, Nagoya, Japan). Feb 1987. Nago Univ., Nagoya, Japan.

In FY 1985 Report of Nagoya Univ., Research Center for Resource and Energy Conservation.

The pore-opening size of ZSM-5 was finely controlled by the chemical vopor deposition (CVD) of silicon methoxide. The silicon compound vapor was deposited, and the deposited material was calcined by oxygen, finally forming a silica-coated zeolite (SiHZSM-5). This was characterized by temperature-programmed desorption of ammonia and adsorption experiments using various molecules. It was found that the silica was deposited only on the external surface and narrowed the pore-opening size effectively with the internal structure unaltered. The fine control of the pore-opening size was tested, exemplified by the conversion of methanol. Hydrocarbon product distribution shifted to smaller molecules over the SiHZSM-5: the formation of smaller olefins such as ethylene and propylene increased in place of the complementary decrease of large aromatics. Enhancement of the product shape selectivity was remarkable in xylene isomers and larger aromatics, which indicated the fine controls of the pore-opening size according to the deposition extent. (6 figs, 3 tabs, 25 refs)

13 HYDRO ENERGY

1301 Resources And Availability

42888 **(NEI-DK—66) GEHBI hydrological province in South Greenland. Hydrological and climatic measurements. Data basis 1987.** (Groenlands Tekniske Organisation, Copenhagen (Denmark)). Aug 1987. 106p. (In Danish). NTIS (US Sales Only), PC A06/MF A01. Order Number DE88752078/JAW.

Reporting of the hydrological measuring programme in Greenland partl takes place in the data reports from GEHBI (GEneral Hydrological Basin Information), and partly in hydrological province descriptions for each individual province. The data report continuously sum up th data basis, and are issued once a year. The hydrological province descriptions are a more detailed hydrological account which is partl used for an evaluation of the entire station and data network, and partly may be used, for example, in the ovarall consideration of the energy resources for the whole province. Of hydrological province descriptions, where only one has been published so far, for Province III - Nuuk - one is prepared and reported each year, i.e. there will be a description for the same province at approx. five-year interval The working party of the Greenland Technical Organization (the "Hydro-Power Group") set this objective at the turn of the year 1985/86, when the grants from the EEC Regional Fund lapsed at the en of 1985. Today the hydrological studies are therefore primarily arranged on the basis of the energy plans for Greenland, taking Paamiut, Nuuk Sisimiut and Ilulissat as their starting point. Consideration being had partly to the performance of the practical work, partly to the locations of the stations in relation to each other plus a theory of a hydrological analogy, the network of measuring stations has been divided up into six hydrological provinces. (editor).

42889 **(NEI-DK—69) Province description. Hydrological province III Nuuk. Climate and hydrological investigations.** (Groenlands Tekniske Organisation, Copenhagen (Denmark)). Aug 1987. 248p. (In Danish). NTIS (US Sales Only), PC A11/MF A01. Order Number DE88752083/JAW.

The hydrological province description for Nuuk (hydrological provinc III, figure 2A) is the first product of a long-term objective for th use of the hydroclimatic knowledge that has been worked up around Western Greenland up to 70 deg. C northern latitude. The collection and processing of hydro-climatic data in Greenland were initiated with an eye on a possible exploitation of the Greenland hydro-power resources. These studies were started right back in the 1970'es, and have ever since contributed to a steadily growing knowledge of the hydro-climatic conditions. The intensity of the studies has varied through the years. With the lapse of the grants from the EEC Regiona Fund at the end of 1985, a reappraisal was made of the collective efforts to exploit the potential hydro-power resources in Greenland. At the turn of the year 1985/86 the working party of the Greenland Technical Organization (the "Hydro-Power Group") therefore worked out an objective for a continuation of the hydro-climatic studies under the new conditions with respect to grants. For at start the hydrological studies are arranged on the basis of the energy plans f Greenland, so they take Paamiut, Nuuk, Sisimiut and Ilulissat as the starting point. Consideration being had partly to the performance of the locations of the stations in relation to each other plus a theor of a hydrological analogy, the network of measuring stations has bee divided up into six hydrological provinces. (EG).

1305 Economics And Management

REFER ALSO TO CITATION(S) 42895

1306 Environmental Aspects

REFER ALSO TO CITATION(S) 43919, 43920, 43921

42890 **(DOE/BP—17579-1) Middle Fork and Upper Salmon River habitat improvement: Implementation plan, FY 1988-1992.** Andrews, J.; Everson, L.B. (USDOE Bonneville Power Administration, Portland, OR). Feb 1988. Contract AI79-84BP17579. 36p. NTIS, PC A03/MF A01;1; GPO Dep. Order Number DE88008500/JAW.

This document presents an implementation plan for completing the phase II portion of the Middle Fork and Upper Salmon River Habitat Improvement Agreement. Underseeding of spawning adult salmon and steelhead, high instream sediment levels, a lack of habitat diversity in the form of overhanging riparian vegetation and edge, and barriers to both adult and juvenile anadromous fish migration were identified as the principal factors limiting anadromous fish production in the project area. Underseeding is being addressed in other projects sponsored and funded by the Bonneville Power Administration while this implementation plan lays out a schedule for resolving the other identified limiting factors. The primary goal of this program is to increase the quality and quantity of anadromous fish habitat (spring chinook and summer steelhead) with an emphasis on the survival of the wild stocks. This goal will be achieved by reducing the impact of sediment loading, improving riparian vegetation, eliminating passage barriers, and increasing habitat diversity. Meeting the above goal will provide off-site mitigation under the manadate of the pacific northwest electric power planning and conservation act of 1980. Project implementation will follow measures in the Northwest Power Council's Columbia River Fish and Wildlife Program. 9 refs., 3 figs., 5 tabs.

42891 **(DOE/BP/39646—2) Imprinting hatchery reared Salmon and Steelhead trout for homing, 1978-1983: Volume 2 of 3, Data summaries: Final report of research.** Slatick, E.; Gilbreath, L.G.; Harmon, J.R.; Bjornn, T.C.; Ringe, R.R.; Walch, K.A.; Novotny, A.J.; Zaugg, W.S. (National Marine Fisheries Service, Seattle, WA (USA). Northwest and Alaska Fisheries Center). Apr 1988. Contract AI79-84BP39646. 127p. NTIS, PC A07;3. Order Number DE88008491/JAW.

The main functions of the National Marine Fisheries Service (NMFS) aquaculture task biologists and contractual scientists involved in the 1978 homing studies were primarily a surveillance of fish physiology, disease, and relative survival during culture in marine net-pens, to determine if there were any unusual factors that might affect imprinting and homing behavior. The studies were conducted with little background knowledge of the implications of disease and physiology on imprinting and homing in salmonids. The health status or the stocks were quite variable as could be expected. The Dworshak and Wells Hatcheries steelhead suffered from some early stresses in seawater, probably osmoregulatory. The incidences of latent BKD in the Wells and Chelan Hatcheries steelhead and Kooskia Hatchery spring chinook salmon were extremely high, and how these will affect survival in the ocean is not known. Gill enzyme activity in the Dworshak and Chelan Hatcheries steelhead at release was low. Of the steelhead, survival in the Tucannon Hatchery stock will probably be the highest, with Dworshak Hatchery stock the lowest. This report contains the data for the narratives in Volume I.

42892 **(DOE/BP/39646—3-Vol.3) Imprinting hatchery reared salmon and steelhead trout for homing, 1978-1983: Volume 3, Disease and physiology supplements: Final report of research.** Slatick, E.; Gilbreath, L.G.; Harmon, J.R.; Bjornn, T.C.; Ringe, R.R.; Walch, K.A.; Novotny, A.J.; Zaugg, W.S. (National Marine Fisheries Service, Seattle, WA (USA). Northwest and Alaska Fisheries Center). Feb 1988. Contract AI79-82BP39646. 467p. NTIS, PC A20;3. Order Number DE88008496/JAW.

The main functions of the National Marine Fisheries Service (NMFS) Aquaculture Task biologists and contractual scientists involved in the 1978 homing studies were primarily a surveillance of fish physiology, disease, and relative survival during culture in marine net-pens, to determine if there were any unusual factors that might affect imprinting and homing behavior. The studies were conducted with little background knowledge of the implications of disease and physiology on imprinting and homing in salmonids. The health status of the stocks was quite variable as could be expected. The Dworshak and Wells Hatcheries steelhead suffered from some early stresses in seawater, probably osmoregulatory. The incidences of latent BKD in the Wells and Chelan Hatcheries steelhead and Kooskia Hatchery spring chinook salmon were extremely high, and how these will affect survival in the ocean is not known. Gill enzyme activity in the Dworshak and Chelan Hatcheries steelhead at release was low. Of the steelhead, survival in the Tucannon Hatchery stock will probably be the highest, with Dworshak Hatchery stock the lowest. This report contains five previously published papers.

42893 **(DOE/BP/64341—1) John Day Fall Chinook/ Salmon Mitigation Plan acclimation and imprinting site feasibility study: Summary report.** (USDOE Bonneville Power Administration, Portland, OR. Div. of Fish and Wildlife; Sverdrup Corp., Bellevue, WA (USA)). Feb 1988. Contract AC79-86BP64341. 561p. NTIS, PC A99;3. Order Number DE88007390/JAW.

The purpose of this Plan is to replace upriver bright fall chinook salmon which were lost by construction of the John Day Dam. This will be accomplished by releasing salmon fry and smolts, incubated in the Spring Creek and Bonneville Hatcheries, at several upriver locations. Prior to release it is desired to feed and acclimate the juvenile fish to relieve the stress of truck transport, and to imprint them to the release site. This will ultimately produce adult chinook salmon that return to their historic spawning areas through traditional common property fisheries. It will also provide sexually mature broodstock fish that can be captured and spawned to supplement continued hatchery operation. This report summarizes results of an engineering feasibility study done for 10 potential acclimation sites on the Columbia, Yakima and Walla Walla Rivers. A detailed report has been prepared for each site and each is bound separately.

42894 **(EPRI-CS/EA/AP—5663-SR) Fish protection at steam and hydroelectric power plants: Proceedings.** Micheletti, W.C. (comp.). (Electric Power Research Inst., Palo Alto, CA (USA)). Mar 1988. 377p. (CONF-8710303—). Research Reports Center, Box 50490, Palo Alto, CA 94303. Order Number TI88920262/JAW.

From Fish protection at steam and hydroelectric power plants; San Francisco, CA, USA (28 Oct 1987).

The objective of this conference was to summarize the state of the art and recent advances in fish protection at steam electric and hydroelectric power plants. Twenty-three papers were presented during four consecutive half-day sessions. In addition, eight progreee reports on recent results or continuing activitites were presented during a fifth half-day session. These proceedings contain the complete text for all twenty-three papers, but do not include any of the progress reports.

1307 Power-conversion Systems

REFER ALSO TO CITATION(S) 43446

42895 **(EPRI-AP—5876) Guide for Hydraulic Machinery Model Testing: Final report.** de Leva, F. (Electric Power Research Inst., Palo Alto, CA (USA); Motor-Columbus Ingenieurunternehmung A.G., Baden (Switzerland)). Jun 1988. 271p. Unlimited audience, publicly available. Research Reports Center, Box 50490, Palo Alto, CA 94303. Order Number TI88012211/JAW.

The Guide for Hydraulic Machinery Model Testing describes the purpose, value, and limitations of hydraulic machinery model testing. Explanations of the advantages of model tests, as well as the risks involved if the tests are not performed, are based on author and industry experience. In addition to general recommendations, specific examples from actual experience are provided. Recommended testing procedures and guidelines are included to ensure that expected prototype performance is achieved and to minimize potential operational problems. Sample model test procedures and cost estimates are provided. 24 refs., 51 figs.

14 SOLAR ENERGY

1404 Environmental, Legal, And Institutional Aspects

42896 **Toxicology of tetramethyltin and other organometals used in photovoltaic cell manufacture.** Hamilton, L.D.; Medeiros, W.H.; Moskowitz, P.D.; Rybicka, K. (Biomedical and Environmental Assessment Division, Brookhaven National Laboratory, Upton, New York 11973). *AIP (American Institute of Physics) Conference Proceedings;* **166**: No. 1, 54-66(15 Jul 1988). (CONF-880112—).

From Photovoltaics safety conference; Denver, CO, USA (19 Jan 1988).

In photovoltaic cell fabrication, organometals (alkyl metals) may be used in such processes as metalorganic chemical vapor deposition, transparent contact oxide deposition, doping, and ion implantation. Although these compounds offer potential performance advantages over earth metals and possibly greater safety in handling than metal hydrides, they are not without risk to health and property. Most organometals can ignite spontaneously in air. Some also react violently with water. Oxidation by-products from these reactions are hazardous to health. Of the organometals used in photovoltaic cell fabrication, only the toxicology of organotins (triethyl-, trimethyl- and tetramethyltin) was studied extensively. In mammalian systems, tetramethyltin is rapidly dealkylated to trimethyltin. Although tin was classified by some investigators as an essential trace element, the effects of organotin compounds on humans are poorly known. Animal studies show that the most prominent effects of trimethyltin are on the central nervous system. Several observations of poisoning were reported; effects ranged from reversible neurologic disorders to death. Limited available data suggest that humans respond to single acute doses and more alarmingly to repeated sub-toxic doses, suggesting a cumulative effect. Toxicologic properties of diethyltelluride also were evaluated in animal experiments. The compound had toxic effects on the blood, liver, kidney, heart, and skin. Based on these studies and others of related compounds (e.g., methylmercury, tributyltin) extreme caution should be exercised in using organometal compounds in photovoltaic cell manufacturing.

42897 **Medical surveillance and biologic monitoring of personnel in semiconductor research facilities.** Krieger, G.; Cambridge, R. (Solar Energy Research Institute, Golden, Colo. 80401). *AIP (American Institute of Physics) Conference Proceedings;* **166**: No. 1, 67-72(15 Jul 1988). (CONF-880112—).

From Photovoltaics safety conference; Denver, CO, USA (19 Jan 1988).

Semiconductor research facilities have many of the same health and safety hazards as large-scale manufacturing plants. The novel and episodic nature of laboratory activity requires a different perspective for medical surveillance and biologic monitoring. Basic principles of medical surveillance for laboratory personnel are reviewed and analyzed. Approaches to biologic monitoring and the role of biologic exposure indices are discussed. Specific types of hazards including dopants, gallium arsenide, toxic inhalations, and physical hazards are placed in a framework consistent with laboratory exposures. Reproductive effects and carcinogenic potential of selected substances are assessed along with possible monitoring strategies.

42898 **Role of unusual occurrence reports in incident analysis in the photovoltaic industry.** Thompson, S. (Solar Energy Research Institute, 1617 Cole Blvd., Golden, Colorado 80401). *AIP (American Institute of Physics) Conference Proceedings;* **166**: No. 1, 73-78(15 Jul 1988). (CONF-880112—).

From Photovoltaics safety conference; Denver, CO, USA (19 Jan 1988).

Incidents affecting operational performance within the photovoltaic industry can be reduced by implementing unusual occurrence reporting systems. This paper identifies the major components of such a system, including background and criteria for determining an unusual occurrence, components of an unusual occurrence report form, and the process cycle from an occurrence to its resolution. Examples of occurrences at the Solar Energy Research Institute (SERI) are presented along with their final results.

42899 **Control of accidental releases of hydrogen selenide in vented storage cabinets.** Fthenakis, V.M.; Moskowitz, P.D.; Sproull, R.D. (Brookhaven National Laboratory, Upton, New York 11973). *AIP (American Institute of Physics) Conference Proceedings;* **166**: No. 1, 79-88(15 Jul 1988). (CONF-880112—).

From Photovoltaics safety conference; Denver, CO, USA (19 Jan 1988).

Highly toxic hydrogen selenide and hydrogen sulfide gases are used in the production of copper-indium-diselenide photovoltaic cells by reactive sputtering. In the event of an accident, these gases may be released to the atmosphere and pose hazards to public and occupational safety and health. This paper outlines an approach for designing systems for the control of these releases given the uncertainty in release conditions and lack of data on the chemical systems involved. Accidental releases of these gases in storage cabinets can be controlled by either a venturi and packed-bed scrubber and carbon adsorption bed, or containment scrubbing equipment followed by carbon adsorption. These systems can effectively reduce toxic gas emissions to levels needed to protect public health. The costs of these controls (~$0.012/W/sub p/) are samll in comparison with current (~$6/W/sub p/) and projected (~$1/W/sub p/) production costs.

42900 **Preventing and controlling accidental gas releases.** Moskowitz, P.D.; Fthenakis, V.M.; Kalb, P.D. (Biomedical and Environmental Assessment Division, Brookhaven National Laboratory, Upton, New York 11973). *AIP (American Institute of Physics) Conference Proceedings;* **166**: No. 1, 161-174(15 Jul 1988). (CONF-880112—).

From Photovoltaics safety conference; Denver, CO, USA (19 Jan 1988).

Toxic, flammable, and explosive gases may be used in photovoltaic cell research laboratories and in commercial manufacturing facilities. Accidental release of these materials can present hazards to life and property. Accidents can arise from a variety of mechanical and human related failures. These can occur from the time materials are received at the loading dock of the facility to the time treated gases are discharged to the atmosphere through a stack. Each type of initiating event may require a different control approach. These may range from the training and certification of plant workers charged with the handling of gas cylinder hookups to installation of emergency pollution control systems. Since engineering options for controlling released materials are limited, emphasis should be placed on administrative and engineering approaches for preventing such accidents. These are likely to be the most effective approaches for protecting life and property.

42901 **National and International centers for Environmental, Health and Safety Information.** Bulawka, A.O. (Photovoltaic Energy Technology Division, U.S. Department of Energy, Washington, D.C. 20585). *AIP (American Institute of Physics) Conference Proceedings;* **166**: No. 1, 229-235(15 Jul 1988). (CONF-880112—).

From Photovoltaics safety conference; Denver, CO, USA (19 Jan 1988).

In February 1987, the U.S. Department of Energy (USDOE) and the Biomedical and Environmental Assessment Division at Brookhaven National Laboratory hosted the First International Expert Working Group Meeting on Environmental, Health and Safety Aspects of Photovoltaic Energy Systems. This meeting was attended by representatives from France/Germany, Italy, Japan and the U.S. Over the course of the two day workshop, discussions focused on the goals, functional needs and responsibilities for national and international assistance centers and on exemplary research tasks. As an outgrowth of this Workshop, USDOE is now finalizing plans to establish a National Assistance Center.

42902 **Applications of fault tree analysis to the design process.** Youngblood, R.W. (Brookhaven National Laboratory, Upton, New York 11973). *AIP (American Institute of Physics) Conference Proceedings;* **166**: No. 1, 236-245(15 Jul 1988). (CONF-880112—).

From Photovoltaics safety conference; Denver, CO, USA (19 Jan 1988).

Fault tree analysis of a system can provide a complete characterization of system failure modes, i.e., what combinations of component failures can give rise to system failure. This can be applied to the design process at several levels: (1) confirmatory analysis, in which a fault tree development is used to verify design adequacy, (2) importance analysis, in which fault tree analysis is used to highlight system vulnerabilities, and (3) design optimization, in which fault tree analysis is used to pick the least expensive configuration from a collection of possibilities satisfying a given constraint. Experience shows that the complexity of real systems warrants the systematic and structured development of fault trees for systems whose failure can have severe consequences.

1405 Solar Energy Conversion

REFER ALSO TO CITATION(S) 42661, 42884, 42885, 42896, 42897, 42898, 42899, 42900, 42902, 43842

42903 **(AC/R—1530) Summary of achievements of agriculture. Canada's Energy, Research and Development in Agriculture and Food (ERDAF) Program.** LeBlanc, D.; Van Die, P. (Canadian Resourcecon Ltd., Calgary, Alberta). Aug 1983. 32p. (CE—01534). CANMET/TID, Energy, Mines and Resources Canada, 555 Booth St., Ottawa, Ont., Canada K1A 0G1; $0.34CAN per page, $3.40 CAN minimum.

In recognition of the importance of energy in Canadian agriculture, research programs have been developed and conducted in areas of agricultural production and in the related processing, distribution and retailing sectors. This report summarizes programs in biogas production, farm machinery efficiency, greenhouses, utilization of industrial waste heat, heat exchangers, farm building ventilation, solar and wind energy applications, biomass combustion, energy crops, liquid fuels production, and energy conservation techniques in the food industry. A list of agricultural energy publications available from the Engineering and Statistical Research Institute is appended. 3 refs., 3 figs.

42904 **(BCR—091983) Bin and silo design for biomass materials. Phase 2.** Bundalli, N.; Morgan, D.; Martinez, O. (B.C. Research, Vancouver (Canada)). Sep 1983. 69p. (CE—01603). CANMET/TID, Energy, Mines and Resources Canada, 555 Booth St., Ottawa, Ont., Canada K1A 0G1; $0.34CAN per page, $3.40 CAN minimum.

An experimental bin was designed and constructed to enable confirmation of results obtained during the first phase of the project on critical bin parameters necessary for reliable discharge of biomass materials. Discharge tests were carried out on three different types of hog fuel and one type of wood chip. Flowability tests were also carried out on laboratory equipment for comparison. Results confirm that simple gravity discharge is possible from outlets that are practical provided that the hopper is of mass flow design. Flow is possible even after storage at rest for periods of at least several weeks without any external flow promoting devices. Ultra high molecular polymer and glass-coated steel, which were both used as bin liners, were found to be suitable for lining mass flow hoppers for biomass. It is anticipated that both those materials can withstand wear and tear under normal services. Problems were experienced with the triple screw feeder build for discharging the bin contents, primarily due to the much larger than anticipated feeder loads. Tests were carried out without the feeder, by using a simple playwood gate. Feeder performance is considered crucial to effective utilization of the mass flow design principles. A feeder must withdraw material uniformly from the whole outlet area as any stagnant zones will lead to bridging. Sufficient information on effective feeder design is not available for the large openings that are necessary for biomass materials. Attention must be given to this area to minimize problems. 2 refs., 14 figs., 10 tabs.

42905 **(BU/F—PIX47EF) Biogeochemistry of temperate forest ecosystem: literature on inventories and dynamics of biomass and nutrients.** Kimmins, J.P.; Binkley, D.; Chatarpaul, L.; deCatanzaro, J. (British Columbia Univ., Vancouver (Canada). Faculty of Forestry; Institut Forestier National de Petawawa, Chalk River, Ontario (Canada); Toronto Univ., Ontario (Canada). Faculty of Forestry; Duke Univ., Durham, NC (USA). School of Forestry and Environmental Studies). 1985. 227p. (EN;FR). (CE—01579). CANMET/TID, Energy, Mines and Resources Canada, 555 Booth St., Ottawa, Ont., Canada K1A 0G1; $0.34CAN per page, $3.40 CAN minimum.

The most fundamental aspect of the resource in both forestry and agriculture is the soil. In unmanaged or low intensity managed forests, the chemical characteristics of soil also reflect regional climate, geology, and landform position, as well as the past history of ecological succession. As the intensity of forest management increases, there is a potential for adverse changes to both physical and chemical aspects of the soil. The physical changes can be serious, longlasting, and difficult to rectify. However, they have a lower probability of occurrence than changes in soil chemistry. Loss of soil organic matter, changes in pH, and alterations in site nutrient status are an almost inevitable outcome of the switch from low to high intensity forest management; these changes will often have a negative impact on future crop production unless appropriate soil amelioration activities and/or site nutrient management are undertaken. Due to the important implications of intensification of forest management on soil fertility, site nutrient management will become an increasingly vital component of forest crop production in the future. The tables in this report summarize some of the available literature on nutrient inputs to ecosystems, the organic matter and nutrient content of forest ecosystems, nutrient dynamics within ecosystems, internal cycling of nutrients within trees, and outputs of nutrients from forest ecosystems. The tables cover mainly temperate and high latitude/altitude forests, and form the bulk of this report. An English-French list of equivalent terms is included. 506 refs., 17 tabs.

42906 **(CONF-880767—2) Long-distance photoinitiated electron transfer through polyene molecular wires.** Wasielewski, M.R.; Johnson, D.G.; Svec, W.A.; Kersey, K.M.; Cragg, D.E.; Minsek, D.W. (Argonne National Lab., IL (USA)). 1988. Contract W-31-109-ENG-38. 13p. NTIS, PC A 03; 3; GPO Dep. Order Number DE88012006/JAW.

From 7. international conference on photochemical conversion and storage of solar energy; Evanston, IL, USA (31 Jul 1988).

Long-chain polyenes can be used as molecular wires to facilitate electron transfer between a photo-excited donor and an acceptor in an artificial photosynthetic system. The authors present data here on two Zn-porphyrin-polyene-anthraquinone molecules possessing either 5 or 9 all trans double bonds between the donor and acceptor, 1 and 2. The center-to-center distances between the porphyrin and the quinone in these relatively rigid molecules are 25 A for 1 and 35 A for 2. Selective picosecond laser excitation of the Zn-porphyrin in 1 and 2 results in the very rapid transfer of an electron to the anthraquinone in < 2 ps and 10 ps, respectively. The resultant radical ion pairs recombine with tau = 10 ps for 1 and tau = 25 ps for 2. The electron transfer rates remain remarkably rapid over these long distances. The involvement of polyene radical cations in the mechanism of the radical ion pair recombination reaction is clear from the transient absorption spectra of 1 and 2, which show strong absorbances in the near-infrared. The strong electronic coupling between the Zn-porphyrin and the anthraquinone provided by low-lying states of the polyene make it possible to transfer an electron rapidly over very long distances.

42907 **(DOE/BP—26139-1) Cost and productivity of multi-product processing equipment for small diameter trees: Final report, 30 September 1986-1 June 1987.** Lambert, M.B.; Howard, J.O.; Hermann, S.E. (USDOE Bonneville Power Administration, Portland, OR). Sep 1987. Contract FG79-85BP26139. 53p. NTIS, PC A04/MF A01;1; GPO Dep. Order Number DE88008506/JAW.

This project evolved from an effort by the land manager, the United States Forest Service, to economically deal with thousands of acres of thick (doghair) Douglas-fir and hemlock forests on Washington's Olympic Peninsula. These forests are very densely stocked and the trees are small. Until this effort, there has been no reasonable way to get enough product from the sites to justify managing them. And, even this project required some special agreements between the landowner and the investigator to be viable. This report describes the in-woods processing system now working in doghair stands on the Quilcene District. As whole trees arrive at the landing, they are sorted by a Cat 225 shovel-type loader. Sawlogs are trimmed, limbed, bucked, and decked for transportation on conventional log trucks. Chip grade trees are passed through a prototype, multi-stem debarker/delimber and then chipped by a Morbark 23" Chiparvester. Clean chips are transported in regular highway chip vans. All other materials, not sold as logs or clean chips, are processed by a prototype shredder, and taken from the site as hogfuel. 7 ref., 15 figs., 11 tabs.

42908 **(EF—ENFOR111985) Intensive short rotation culture of hybrid poplar for energy on Prince Edward Island. Final report.** McCabe, P.L.; Glen, W.M. (Department of Energy and Forestry, Charlottetown, Prince Edward Island (Canada)). Nov 1985. 68p. (CE—01637). CANMET/TID, Energy, Mines and Resources Canada, 555 Booth St., Ottawa, Ont., Canada K1A 0G1; $0.34CAN per page, $3.40 CAN minimum.

A 1984 study of energy alternatives for Prince Edward Island has identified wood energy as the most viable energy option for industrial, institutional and residential space heat. A hybrid poplar experiment was established on Prince Edward Island consisting of two sites combining two clones, three planting densities and four fertilizer levels. This report details the results of one year's growth on one site, and two years' growth on the second, both on the four year old rootstock. The highest one year production level was 8.27 ODT/ha on the Upton Road site with clone number 79, with a high planting density and no fertilizer. The highest two year production level was 12.12 ODT/ha with clone number 79, with a medium planting density and 400 kg of nitrogen fertilizer/ha. Soil and tissue analysis results are included. Costs of production were calculated from this study, and were compared to the cost of production for biomass from natural stands. The production cost was lower for biomass from natural poplar stands ($19.12/ODT), than for the most economic cultivated stands ($53.16/ODT). 9 refs., 9 figs., 14 tabs.

42909 **(EPS—3AP754) Combustion technology for the disposal and utilization of wood residue.** (Environment Canada, Ottawa, Ontario. Environmental Protection Service). May 1975. 92p. (CE—01622). CANMET/TID, Energy, Mines and Resources Canada, 555 Booth St., Ottawa, Ont., Canada K1A 0G1; $0.34CAN per page, $3.40 CAN minimum.

This report provides a state-of-the-art review of emerging technology for the utilization and disposal of wood residues with emphasis on air pollution potential and cost. Disposal by thermal decomposition is emphasized and utilization is limited to useful energy aspects. The study is limited to those residues generated and useable at a wood processing facility, and is confined to British Columbia operations. There is currently surplus of wood residue from facilities in the interior of the province. Wood might be harvested or cultivated specifically as an economically competitive energy source. However, present wood-fired boilers cost 2-4 times as much as equivalent conventional boilers. Increasing emphasis on environmental quality has resulted in serious wood waste disposal problems for many facilities. Seven different systems are identified and discussed for on-site disposal. Modified conical and pit incinerators are appropriate for smaller mills; the other 5 systems are more suitable for larger mills having a demand for the clean, hot gases that these systems produce. Fluidized bed combustors and gasification units provide systems producing gases that may be used directly in gas turbines; charcoal reactors produce a marketable product plus clean, combustible gas. The air pollution potential of the 7 systems is also reviewed. Marketable products can also be derived from some wood residues, e.g. wood chips, sawdust, charcoal, activated carbon, and fire logs. Central regional energy plants using wood waste can be designed to meet requisite environmental standards. They could produce electricity by established technology, or syn-

thetic natural gas or fuel-grade methanol by known technology. 13 refs., 24 figs., 24 tabs.

42910 **(FBE—1) Forest nutrient cycles as affected by climate, species composition, stand age and intensive harvesting.** Johnson, D.W. (Forest Biomass Energy, Toronto, Ontario (Canada)). 1985. 15p. (CE—01560). CANMET/TID, Energy, Mines and Resources Canada, 555 Booth St., Ottawa, Ont., Canada K1A 0G1; $0.34CAN per page, $3.40 CAN minimum.

Patterns of nutrient cycling and distribution vary systematically with respect to climate, species composition and stand age. Forest floor mass and nutrient content increase with stand age up to a maximum value which is determined by litterfall and decomposition rate. Litterfall and decomposition are greater in warmer climates, but maximum forest floor weight decreases in warm climates because decomposition rates increase more rapidly than litterfall with increasing temperature. Thus, the age at which the forest floor reaches a steady-state decreases from cooler to warmer climates. Maximum forest floor mass and the age at which it is reached are generally lower in deciduous forests than in coniferous forests. Deciduous forests take up, recycle, and accumulate greater amounts of nutrients per unit of biomass produced than coniferous species, but exceptions to this rule are noted. Intensive, short-rotation harvesting will cause large changes in nutrient distribution and fluxes, especially in cooler climates. Shortening rotations will accelerate nutrient outputs (both by biomass removal and leaching) and may require increased inputs (fertilization) while simultaneously reducing the maximum accumulation of nutrients in tree biomass and the forest floor. Prevention of large forest floor accumulations is an especially significant change for cool, conifereous forests but is less so for warm and/or deciduous forests where forest floors naturally reach a steady-state early in stand development. 35 refs., 5 figs.

42911 **(FERIC—SR21) Salvaging sound wood chips from decadent Cedar-Hemlock logging residue.** Sinclair, A.W.J.; Berlyn, R.; Manning, G. (Forest Engineering Research Inst. of Canada, Vancouver, British Columbia; Pacific Forest Research Centre, Victoria, British Columbia (Canada); Pulp and Paper Research Inst. of Canada, Pointe Claire, Quebec). 1985. 22p. (CE—01658). CANMET/TID, Energy, Mines and Resources Canada, 555 Booth St., Ottawa, Ont., Canada K1A 0G1; $0.34CAN per page, $3.40 CAN minimum.

Sheared, decadent hemlock and cedar logging residues from a test of the Nicholson Residue Shear were chipped and upgraded (bark, rot and fines removed) to determine their suitability for pulping. In one test bolts were chipped with bark on, and the resulting material upgraded through the Paprifer process. In a second test, bolts were debarked in a drum debarker, then chipped. In both cases, rot remained at unacceptably high levels. Drum debarking reduced bark to acceptable levels; however, the Paprifer process did not remove sufficient bark, possibly due to dry, refractory bark. Further work is required on methods to remove rot from sheared, decadent material. 3 refs., 6 figs., 11 tabs.

42912 **(FERIC—SR28) 1984 field testing of the experimental prototype of the Dual Roll Splitter.** DuSault, A. (Forest Engineering Research Inst. of Canada, Pointe Claire, Quebec). May 1985. 51p. (CE—01639). CANMET/TID, Energy, Mines and Resources Canada, 555 Booth St., Ottawa, Ont., Canada K1A 0G1; $0.34CAN per page, $3.40 CAN minimum.

The Roll Splitter is an experimental prototype equipped with two consecutive pairs of rollers–smooth uppers, bars of teeth on lowers. It combines dewatering, splintering and crushing functions, and can process bolts of up to 16 cm (6 in.) in diameter. The tests were conducted on three woody species (yellow poplar, red maple and loblolly pine) and aimed at quantifying the dewatering ability of the Roll Splitter, its energy requirements, and the drying rate of the crushed material. Mechanical dewatering averaged 9.9% for yellow poplar, 9.0% for loblolly pine and 5.3% for red maple, with values ranging from 1% to 21%. After five days of air drying with sun exposure, the residues of yellow poplar, loblolly pine and red maple underwent a reduction of moisture content of 90.5%, 89.5% and 50.5% repsectively. Dewatering and drying appeared to be most effective with high initial moisture content material. Cycle comminution energy amounted to 622 MJ/ODT for the yellow poplar, 630 MJ/ODT for the loblolly pine and 732 MJ/ODT for the red maple. In the same order, machine comminution energy was 4.0 MJ/Kg water. In contrast to a former version equipped with a single pair of rollers, machine comminution energy doubled and machine dewatering energy remained to same. Roller speeds affected mechanical dewatering and quality of splinters, particularly in the case of yellow poplar. With the same species, dewatering capacities are significantly increased with two pairs of rollers as opposed to a single pair. With medium and high density species, for instance red maple, high crushing forces do not necessarily improve roll-crushing quality. Although the high resilience of crushed material might impede drying, it could facilitate subsequent baling and compaction operations.

42913 **(FERIC—SR30) Evaluation of forest biomass compaction systems.** Guimier, D.Y. (Forest Engineering Research Inst. of Canada, Pointe Claire, Quebec). Aug 1985. 62p. (CE—01640). CANMET/TID, Energy, Mines and Resources Canada, 555 Booth St., Ottawa, Ont., Canada K1A 0G1; $0.34CAN per page, $3.40 CAN minimum.

The objective of the study was to identify all types of compaction systems. This report presents the results of tests using a round agricultural baler, square baler, (paper and scrap metal presses) garbage truck, garbage container-compactor, and cotton module builder. The tests were conducted with a mixture of small trees, branches, tops and hard wood brush. It was found that the square baler and the cotton module builder showed the most promise for the compaction of forest residues at roadside. The VPI square baler produced a 1 m/sup 3/ bale of between 500-980 kg/m/sup 3/ with a volume reduction of 50-80%. The cotton module builder produced a 45 m/sup 3/ bale of 357 kg/m/sup 3/ with a 0.62 volume reduction. Among the prototypes specifically developed to handle woody biomass, three major types were found: balers and bundlers, on-truck compactors, and densifiers. The VPI baler concept appears well suited to the Canadian need for a baler that can handle logging slash at roadside. On-truck compactors are mainly of interest when transporting tree sections or whole trees. Densification is an energy hungry process best suited for fixed installaton. In the forest biomass harvesting system, compaction can be performed either before or after chipping; compaction could also be used as an alternative to comminution in which case new energy conversion systems capable of handling whole bales have to be designed. 25 refs., 32 figs., 14 tabs.

42914 **(FERIC—SR35) Transport of full trees over public roads in eastern Canada. A state of the art report.** Silversides, C.R.; Moodie, R.L. (Forest Engineering Research Inst. of Canada, Pointe Claire, Quebec). Dec 1985. 71p. (CE—01641). CANMET/TID, Energy, Mines and Resources Canada, 555 Booth St., Ottawa, Ont., Canada K1A 0G1; $0.34CAN per page, $3.40 CAN minimum.

The economics of full tree harvesting and transport are gradually being recognized in those situations where the bark, limbs and tree tops can be utilized. Because of the constraints of highway regulations, there has been little effort to transport full trees over public roads. The concern is to obtain an economic payload and to be able to contain the full trees to public highway standards. This report discusses the different characteristics of the load, analyzes the economic load capacity, estimates hauling costs under Canadian conditions, and describes developments in tree transport equipment and techniques. Full trees provide a load which is extremely nonuniform in size, weight and configuration. For this reason they present uneven weight both longitudinally and laterally and their bushiness creates a low bulk density. Full trees have been transported successfully and economically in Canada with off-road trucks on private roads where size and weight constraints do not apply. Full trees have been transported successfully for the past six years on public roads in Germany. Trials in Finland, Norway and Denmark met with limited success and have been dropped. The transport of tree sections, where unlimbed trees are cut to a predetermined maximum length, is under wide development in Sweden and Finland. Tree sections increase bulk density and permit better load distribution than do full trees, but require additional labor in the field. In the USA full trees are transported on private roads. Thinnings from

forest plantations in the southern States have been successfully transported in specially designed trailers on public roads. 45 refs., 39 figs., 18 tabs.

42915 **(FERIC—SR36) The development and trial of two prototype machines (RECUFOR and LRP) for forest biomass recovery.** DuSault, A. (Forest Engineering Research Inst. of Canada, Pointe Claire, Quebec). Dec 1985. 37p. (CE—01638). CANMET/TID, Energy, Mines and Resources Canada, 555 Booth St., Ottawa, Ont., Canada K1A 0G1; $0.34CAN per page, $3.40 CAN minimum.

The RECUFOR prototype (a mobile collecting, comminuting and transporting unit) was built in 1982 as the result of the first stage of the project. The RECUFOR was capable of entering the logging site and recover, with a collecting drum, on-the-ground logging residues such as tops, branches, on cutovers, comminuting this material into size suitable for handling, storing, transporting and unloading residues at roadside. Before the outset of performance testing, logging residues averaged 29.4 cm in depth and covered approximately 41% of the cut over. Residues were generally laid out in parallel rows, typical of Koehring shortwood operations. On the whole, the prototype performance during the trials established that the basic concept of recovering residues left on logging sites was technically feasible, but that the recovery costs for this type of biomass were too high to develop this machine further towards a commercial unit. Productivity level was only 3.39 green tonnes/PMH (Productive Machine Hour). A second prototype, called the Logging Residue Processor (LRP), was then built in order to follow the change of world energy needs and Canadian logging practices that occurred in the 1980-82 period. The LRP is a self-propelled machine, which travels on logging roads recovering residues left at roadside after whole-tree delimbing operation. The tests were conducted in the backyard of a plant, where residues were piled up to a height of six feet and laid out in rows. Residues consisted of freshly cut small hemlock, spruce, cedar and some aspen trees. Some preliminary tests on the LRP were undertaken in 1984, and the test results indicated that a productivity level of 20 green tonnes SMH (Scheduled Machine Hours) could be reached if some modifications on the prototype were made. 7 refs., 16 figs., 10 tabs.

42916 **(IIUG-rep—86-14) Agriculture and the prospects of industrial non-food biomass utilization in West Germany.** Brueggemann, B.; Riehle, R.M. (Wissenschaftszentrum Berlin fuer Sozialforschung gGmbH (WZB) (Germany, F.R.). Internationales Inst. fuer Umwelt und Gesellschaft). 1986. 99p. NTIS (US Sales Only), PC A05. Order Number DE88753779/JAW.

This study examines agricultural structures and the current discussion over alternative uses for land in the Federal Republic of Germany. It considers the prospects and problems related to ethanol production, utilization of sugar, starches, plant and animal fats, and of lignocellulose in industrial production, and evaluates the likely impacts on farmers and farmworkers. On the basis of their analysis, the authors come to the following main conclusions: If the possibilities for using biomass are seen only in terms of land and if the regional and product-specific differences in the structure of land ownership are neglected, agricultural policy options will be largely divorced from reality. The discussion on whether ethanol production makes sense is highly controversial. In any case, ethanol production is unlikely to offer a realistic perspective for small farms and less favoured areas. The economic prospects of short rotation forestry for energy purposes are uncertain. The use of residual wood and straw may be well appropriate for farms. Only if heating systems and the processing and distribution of agricultural and forestry residuals are further developed, and costs reduced, wood and straw residuals will be used on a larger scale. The cultivation of industrial crops (such as sugar, starch, oils, and fats) will not lead to large additional land requirements in the near future. Increased utilization of industrial crops by industry will strongly depend upon appropriate progress in biotechnological research. (orig.)

42917 **(KA—061985) Configuration of small scale biomass harvesting and transport systems. Final report.** (Kipping and Associates Ltd., Fredericton, New Brunswick (Canada)). Jun 1985. 151p. (CE—01561). CANMET/TID, Energy, Mines and Resources Canada, 555 Booth St., Ottawa, Ont., Canada K1A 0G1; $0.34CAN per page, $3.40 CAN minimum.

A study was performed to configure nominal 25, 50, and 100 green tonne/day whole-tree chip harvesting systems and to evaluate the economic feasibility of operating these systems as independent businesses on private woodlands in the Canadian maritime provinces. Representative small cable skidders, mobile wood chippers, feller-bunchers, grapple skidders and semi-trailer chip vans were evaluated for production capacity, utilization, and unit cost of production when operating at the desired harvesting system capacities. Optimum systems were then designed for nominal production rates of 25, 50, and 100 tonne/day using this equipment. A discounted cash flow analysis was performed in each case to assess economic viability. For current market price range for fuel chips ($14-$16/green tonne), the results indicate clearly that none of the determined small scale systems is economically viable as an independent business. At current prices for whole-tree chips for fiber ($25-$27/green tonne), two systems were determined to satisfy the economic viability criteria. The first, based on felling with chainsaw, cable skidding, and production at 120 tonne/day, was determined to be preferable to the second best alternative, a feller-buncher/grapple skidding type system which would also produce at 120 tonne/day. A nominal 50 tonne/day cable skidding based system configuration was also determined to be promising if operated in favourable circumstances. Includes appendices of reprints of manufacturers' specifiactions for various types or harvesting equipment. 17 refs., 3 figs., 23 tabs.

42918 **(NFRC—NX226) An introduction to European willows.** Robertson, A. (Newfoundland Forest Research Centre, St. John's (Canada)). 1984. 41p. (CE—01570). CANMET/TID, Energy, Mines and Resources Canada, 555 Booth St., Ottawa, Ont., Canada K1A 0G1; $0.34CAN per page, $3.40 CAN minimum.

As a short rotation agroforestry crop, willow coppice and osier production dates back to early Greek and Roman civilizations. Within the last decade, willows have again become attractive as a cheap, fast-growing energy source. New research and development programs on short-rotation energy plantations are underway in Sweden, Eire, Britain, Finland, New Zealand and, more recently, Canada and USA. This report provides a basic introduction to European willows in general and the potential of commercial species in particular. Characteristics and natural distribution are detailed for 10 species and their varieties. Historical notes include selected examples of early uses and mythology that influenced contemporary perception and cultivation of willows. The problem of willow hybridization is also discussed. 52 refs., 30 figs.

42919 **(NSBG—011986) Feasibility for development of an aquaculture facility at Hot Spring Cove.** (Nevin Sadlier-Brown Goodbrand Ltd., Vancouver, British Columbia (Canada); Northern Thermal Aquatech Ltd., Victoria, British Columbia (Canada)). Jan 1986. 77p. (CE—01651). CANMET/TID, Energy, Mines and Resources Canada, 555 Booth St., Ottawa, Ont., Canada K1A 0G1; $0.34CAN per page, $3.40 CAN minimum.

This report describes the feasibilty of obtaining geothermally warmed water for use in aquaculture at Hot Springs Cove, British Columbia, and concludes that while the sources can probably be assessed from two sites in the cove, neither this nor the quantity of water available can be known for certain without field trials. The report also examines the feasibility of culturing various species of sea life at Hot Springs Cove, and concludes that a combination of rearing coho salmon smolts and oysters, with the late addition of tilapia, appears to be the most suitable both for biological and economic reasons. The total capital investment amounts to about $1,033,000. Operating costs would be about $450,000 annually, and additional capital to cover this would be needed in the first years of operation. A business plan is provided which includes cash flow projections for the first nine years of operation, and this shows that

a maximum investment of approximately $1.2 million would be needed by the third year of operation. If sufficient warm water is available, and the facility is operated successfully, it should pay off the investment in seven to nine years, provided that interest free loans are available for capital investments. 20 refs., 1 fig., 8 tabs.

42920 (NUSE—8601, pp 180-183) **Plasma polymerization of N-vinylcarbazole thin films and its phtoconduction.** Takai, Yoshiaki; Morita, Hiromasa; Inoue, Masumi; Mizutani, Teruyoshi; Ieda, Masayuki. (Nagoya Univ., Faculty of Engineering, Nagoya, Japan). Feb 1986. (In Japanese). Nagoya University, Nagoya, Japan.

In FY 1984 Report of Nagoya Univ., Research Center for Resource and Energy Conservation.

As one of the trials of applying plasma polymerization to the polymerization of functional high polymer, N-vinylcarbazole, monomer of polyvinylcarbazole, which had already been used widely as polymer photoconductor, was formed through plasma polymerization. In addition, at the same time of studying its structure from its infrared absorption spectrum, the examination of its photoconductive characteristics and the effect of adding trinitroflorenon (TNF) was also made. As the results, it was revealed that its chemical structure was similar to the polyvinylcarbazole available in the market. It was also found that its photocurrent spectrum was likewise very similar to that of polyvinylcarvazole and the photocurrent was sensitized by TNF doping. It was also shown that this photocurrent was in the rate determining process of carrier generation. Since it did not show the thickness dependency and was proportional to the light intensity.(9 figs, 6 refs)

42921 (NUSE—8601, pp 173-179) **Study on the plasma polymerisation of phenylacetylene and its electrical properties.** Takai, Yoshiaki; Inoue, Masumi; Mizutani, Teruyoshi; Ieda, Masayuki. (Nagoya Univ., Faculty of Engineering, Nagoya, Japan). Feb 1986. (In Japanese). Nagoya University, Nagoya, Japan.

In FY 1984 Report of Nagoya Univ., Research Center for Resource and Energy Conservation.

In recent years, conducting and semiconducting polymers have been studied, but it is not very easy to produce films with thickness below 1 μm by conventional methods. Accordingly, the plasma polymerisation method was tested. Its results are reported below. The plasma polymerisation of phenylacetylene (PA) was carried out at 13.5MHz and its electrical properties and structure were investigated. The plasma-polymerised PA films were found to have chemical structure similar to that of chemically polymerised polyphenylacetylene, in a short range of molecular chains. These films were found to be electrically insulating. They showed also substantial photoconductivity at long wavelengths such as 700nm; this was found to arise from the excitation of trapped charges. The doping of the plasma-polymerised PA films with iodine increased both the photoconductivity and the dark conductivity. (7 figs, 1 tab, 10 refs)

42922 (NUSE—8701, pp 86-90) **Plasma-CVD of polyvinyl carbazole thin films and their photoconductive properties.** Ieda, Masayuki; Takai, Yoshiaki; Inoue, Masumi; Morita, Hiromasa; Mizutani, Teruyoshi. Feb 1987. Nago Univ., Nagoya, Japan.

In FY 1985 Report of Nagoya Univ., Research Center for Resource and Energy Conservation.

Recently there has been increasing interest in the organic functional polymers. In particular, organic photoconductors are currently being used in electrophotography. Complexes of poly-n-vinylcarbazole (PVK) and 2,4,7 trinitro-9-fluorenone (TNF) were known to have good photoconductive properties. Generally, these photoconductors are prepared by casting from the solution on a substrate. It is, however, not easy to make thin films less than micron meters with no pinholes. A plasma-CVD technique was applied to prepare organic photoconductors. In this work, the chemical structure and photoconductive properties of the plasma-polymerized polyvinyl carbazole (P-PVK) were discussed. The IR and UV spectroscopies showed that the chemical structure was similar to that of the conventional PVK. The efficiency and fill factor as an organic photocell were roughly 3 x 10^{-3}% and 0.25 respectively. It is significant that a film with the same level of characteristics with the conventional polymer was obtained by a plasma polymerization method. (5 refs)

42923 (NUSE—8701, pp 79-85) **Study on the plasma polymerization of phenylacetylene and its electrical properties.** Takai, Yoshiaki; Inoue, Masumi; Ieda, Masayuki. Feb 1987. Nago Univ., Nagoya, Japan.

In FY 1985 Report of Nagoya Univ., Research Center for Resource and Energy Conservation.

The plasma polymerization of phenylacetylene (PA) was carried out at 13.56MHz and its electrical properties and structure were investigated. The plasma-polymalized PA films were found to have chemical structure similar to that of chemically polymalized PA, in a short range of molecular chains. These film were found to be electrically insulating. They also showed substantial photoconductivity at long wavelengths such as 700 nm; this was found to arise from the excitation of trapped charges. The doping of the plasma-polymerized PA films with iodine increased both the photoconductivity and the dark conductivity.(7 figs, 1 tab, 10 refs)

42924 (PNFI—PIX55) **Equations for estimating aboveground nutrient content of six eastern Canadian hardwoods.** Chatarpaul, L.; Burgess, D.; Methven, I.R. (Institut Forestier National de Petawawa, Chalk River, Ontario (Canada); New Brunswick Univ., Fredericton (Canada). Dept. of Forest Resources). 1985. 19p. (CE—01655). CANMET/TID, Energy, Mines and Resources Canada, 555 Booth St., Ottawa, Ont., Canada K1A 0G1; $0.34CAN per page, $3.40 CAN minimum.

Nutrient concentrations and biomass of various components of six eastern Candian hardwood species, representing a range of diameter and height classes, were determined and used to estimate nutrient masses for each species and for components. One hundred and fifty (6 species x 5 components x 5 nutrients) linear regression equations were developed using nutrient mass, diameter, and height data. Nutrient concentrations varied widely among components, with twigs/leaves, for example, containing 14 times as much nitrogen (1.246% to 0.087%) and 17 times as much phosphorous (0.137% to 0.008%) as the stem wood. Generally, twigs/leaves accounted for the highest percentage of nitrogen and phosphorous, stem wood had had the most potassium and magnesium, and stem bark contributed the greatest amount of calcium. The single equations, with few exceptions, had high r/sup 2/ and low SEE%, showing good fit of data to the simple linear model. The equations for all components (except twigs/leaves) of trembling aspen, sugar maple, red maple, and ironwood were not significantly different ($P < .05$) and could therefore be combined into a single equation. However, those of red oak and white birch were significantly different. The application of the four-species combined equations to stand data showed nutrient removals by full-tree harvesting could increase by 56% to 111% with the percentage increase in the order $P \sim N > Mg > K = Ca$. 20 refs., 5 tabs.

42925 (SERI/STR—211-3343) **Research on high-efficiency, single-junction, monolithic, thin-film amorphous silicon solar cells: Semiannual subcontract report No. 3, 1 December 1985--31 May 1986.** Aspen, F.E.; Grimmer, D.P.; Jacobson, R.L.; Jeffrey, F.R.; Tran, N.T. (Solar Energy Research Inst., Golden, CO (USA); Minnesota Mining and Mfg. Co., St. Paul (USA). Electronic and Information Sector Labs.). Jun 1988. Contract AC02-83CH10093. 54p. NTIS, PC A04/MF A01; 1; GPO Dep. Order Number DE88001176/JAW.

This report describes progress in research on high-efficiency, single-junction into five lithic, thin-film amorphous silicon solar cells. The work was divided into five tasks, which include research on a-Si materials; nonsemiconductor materials; web growth; and monolithic, intraconnected cells and submodules. Also described is work done with a multichamber deposition system. Results included achieving an optical band gap of 1.73-1.75 eV in the intrinsic i-layer. A new roll coater was acquired for use as a multilayer transparent top-contact deposition system. Textured substrates were also investigated to increase the short-circuit current. In doping profile work, a model indicated that a carbon profile could be used in place of the boron profile to raise the open-circuit voltage. Silver-filled epoxy-ITO contacts were found to be unstable over time. Two-web growth methods were demonstrated to obtain submodule

performance that is about 80% of small-area (1 cm ^{2}) efficiency. With the multichamber deposition system, a-Si p-i-n layers were deposited onto metallized polyimide web in a continuous, roll-to-roll process. 11 refs., 36 figs., 2 tabs.

42926 (SERI/TP—211-3361) Electronic structure of electrodeposited thin film CdTe solar cells. Ullal, H.S. (Solar Energy Research Inst., Golden, CO (USA)). May 1988. Contract AC02-83CH10093. 16p. NTIS, PC A03/MF A01; 1; GPO Dep. Order Number DE88001170/JAW.

Independent experimental verification done at four research laboratories, namely, Ametek, Colorado State University (CSU), Institute of Energy Conversion (IEC), and Solar Energy Research Institute (SERI) confirm the n-i-p model proposed by Ametek. The experiments done for the verification of the n-i-p structure are the high frequency capacitance-voltage, light and voltage bias quantum efficiency, and EBIC measurements. All experimental evidence suggests that the n-i-p model is appropriate for the existing n-CdS/i-CdTe/p-ZnTe cell structure. From the C-V measurements, the depletion width has been estimated at 1.7-2.0 μm and corresponds to the thickness of the CdTe film. This unique thin films device design has resulted in improved stability and a SERI-verified world record single-junction total area AM1.5 global efficiency of 11%. Further refinements in device design and cell processing should result in 12-13% efficiencies for thin-film CdTe solar cells in the not-too-distant future.

42927 (TLRC—BCX264) Development of biomass equations for British Columbia tree species. Standish, J.T.; Manning, G.H.; Demaerschalk, J.P. (Talisman Land Resource Consultants, Vancouver, British Columbia (Canada); British Columbia Univ., Vancouver (Canada). Faculty of Forestry; Pacific Forest Research Centre, Victoria, British Columbia (Canada)). 1985. 48p. (CE—01617). CANMET/TID, Energy, Mines and Resources Canada, 555 Booth St., Ottawa, Ont., Canada K1A 0G1; $0.34CAN per page, $3.40 CAN minimum.

Biomass equations were developed for 22 commercial tree species covering all British Columbia except the northern part of the province and the Queen Charlotte Islands, based on 1,155 sample trees. Trees were destructively sampled, equations based on breast-height diameter squared times total height, and multiple linear equations based on breast height diameter, total height and volume and their interactions were developed. Both forms of equations give reasonably accurate and precise predictions, and choice depends on the use to which the biomass equations will be put. 24 refs., 2 figs., 29 tabs.

42928 Light-induced degradation in undoped hydrogenated amorphous silicon films studied by the surface photovoltage technique: A comparison of lifetime versus space-charge effects. Hegedus, S.S.; Lin, H.; Moore, A.R. (Institute of Energy Conversion, University of Delaware, Newark, Delaware 19716). *Journal of Applied Physics;* **64**: No. 3, 1215-1219(1 Aug 1988).

The calculation of the space-charge density under illumination from surface photovoltage measurements has been adapted to analyze light-soaking experiments in intrinsic hydrogenated amorphous silicon (a-Si:H). We find that the positive space-charge densities increase and the space-charge widths decrease with light exposure while very little change occurs in the hole diffusion length. These results indicate that changes in electric field distribution with light soaking are important causes of degradation of amorphous silicon solar cells, rather than changes which may ocur in the hole diffusion length. We also review and discuss results of others regarding application of the surface photovoltage (SPV) to study light-induced phenomena, evidence of two different types of light-induced defects, and potential limitations of SPV in a-Si:H.

42929 Ion beam rehydrogenation and post-hydrogenation of a-Si:H. Tsuo, Y.S.; Deng, X.J.; Smith, E.B.; Xu, Y.; Deb, S.K. (Solar Energy Research Institute, Golden, Colorado 80401). *Journal of Applied Physics;* **64**: No. 3, 1604-1607(1 Aug 1988).

We have studied the rehydrogenation and post-hydrogenation of a-Si:H using a Kaufman ion beam source. The achievement of an air-mass-one (AM1), photo-to-dark conductivity ratio of 5.6 x 10^5 with a rehydrogenated a-Si:H sample was reported earlier [Y. S. Tsuo, E. B. Smith, and S. K. Deb, Appl. Phys. Lett. 51, 1436 (1987)]. In this communication we report recent results of the rehydrogenation study and new results of a study of the post-hydrogenation of amorphous silicon deposited by glow discharge at 480 °C. AM1 photo-to-dark conductivity ratios as high as 9.5 x 10^6 (with a photoconductivity of 8.6 x 10^{-6} Ω cm^{-1}) and 1.1 x 10^5 (with a photoconductivity of 6.3 x 10^{-6} Ω cm^{-1}) have been obtained with a rehydrogenated sample and a post-hydrogenated sample, respectively. We also report the results of the hydrogen depth profile and photostability measurements of these samples.

42930 Antarctic benthic and sea-ice microalgal interactions: food chain processes and physiology. Smith, G.A.; White, D.C.; Nichols, P.D. (Oak Ridge National Lab., TN (USA)). *Antarctic Journal of the United States;* **21**: No. 5, 174-175(1986).

Annual sea-ice in McMurdo Sound is known to provide an extensive microhabitat for microalgae containing a high biomass within the lower 5 cm at the water/ice interface, with an estimated annual production of 4.1 g of carbon/m^2. Upon senescence, this microalgal population contributes a large amount of C to the benthic biota. Total biomass as measured by membrane phospholipids of benthic microorganisms from three sites in McMurdo Sound were comparable to those of a Florida estuary and greater than those of deep-sea trenches. In addition to total biomass, changes in community structure of the sediments at the McMurdo study sites of Cape Evans, Cape Armitage, and New Harbor are detectable by detailed fatty-acid profiles of phospholipid membranes. These data are comparable to studies of the benthic macrofauna from McMurdo Sound which indicated that the east Sound sites are more productive than the west. The east Sound sediment sites were found to contain the greatest amount of the phospholipid fatty acid which is a major component of the sea-ice diatom Nitzschia cylindrus. Bacterial biomarkers indicated little difference in total biomass between the sites but did reveal community structure differences. Saturated, branched, and odd carbon fatty acids, were present in similar relative proportions. Fatty acids from triglyceride and sterols from the neutral lipid fractions of the sediments indicated a similar pattern to that of the phospholipid biomasses, with the east Sound sites containing greater amounts. Metabolic activities at the sites were measured by their incorporation of radiolabeled precursors into bacterial DNA and lipid classes. Lipid and metabolic activity monitoring has proven to be a useful technique in ice algal physiology studies.

42931 Changes in photosynthetic metabolism of sea-ice microalgae during a spring bloom in McMurdo Sound. Palmisano, A.C.; Smith, G.A.; White, D.C.; Nichols, P.D.; Lizotte, M.P.; Cota, G.; Sullivan, C.W. (National Aeronautics and Space Administration, Moffett Field, CA (USA)). *Antarctic Journal of the United States;* **21**: No. 5, 176-177(1986).

Microalgae, primarily diatoms, bloom in the lower layers of coarse-grained congelation ice and platelet ice during the austral spring at McMurdo Sound, Antarctica. The purpose in the 1985-1986 field season was to examine changes in photosynthetic metabolism that occur during the development and decline of the spring bloom of sea-ice microalgae. The authors have proposed that sea-ice microalgae may serve as a model system for studying growth phase-related changes in physiology of natural populations of microalgae. Because they are physically trapped within the brine channels and pockets that permeate sea ice, a single community may be repetitively sampled throughout the bloom period. The seasonal study of photosynthetic metabolism included the following parameters: carbon assimilation into crude fractions of protein, lipids, carbohydrates, and small molecular weight metabolites; carbon assimilation into specific lipid fractions: neutral lipids, glycolipids, and phospholipids; identification of key lipid components by gas chromatography/mass spectrometry; photosynthesis/light relationships; release of extracellular organic carbon; and analysis of pigment composition: chlorophylls, carotenoids, and breakdown products.

1406 Photovoltaic Power Systems

42932 (ORNL/Sub—81-09079/1) The development of a unique power converter: Final report. Suelzle, L.R. (Oak Ridge National Lab., TN (USA)). May 1988. Contract AC05-84OR21400. 47p. NTIS, PC A03/MF A01; 1; GPO Dep. Order Number DE88013349/JAW.

The work deals with the development of a 5-kW, utility-interactive dc-to-ac power converter that uses a new control concept to operate from a source of dc power and provide quality ac output power to the utility grid. 5 refs., 11 figs.

42933 (SAND—87-7017) Reduced order modeling of grid-connected photovoltaic inverter systems. Wasynczuk, O.; Krause, P.C.; Anwah, N.A. (Purdue Univ., Lafayette, IN (USA). School of Electrical Engineering). Apr 1988. Contract AC04-76DP00789. 117p. NTIS, PC A06/MF A01;1; GPO Dep. Order Number DE88010603/JAW.

This report summarizes the development of reduced order models of three-phase, line- and self-commutated inverter systems. This work was performed as part of the National Photovoltaics Program within the United States Department of Energy and was supervised by Sandia National Laboratories. The overall objective of the national program is to promote the development of low cost, reliable terrestrial photovoltaic systems for widespread use in residential, commercial and utility applications. The purpose of the effort reported herein is to provide reduced order models of three-phase, line- and self-commutated PV systems suitable for implementation into transient stability programs, which are commonly used to predict the stability characteristics of large-scale power systems. The accuracy of the reduced models is verified by comparing the response characteristics predicted therefrom with the response established using highly detailed PV system models in which the inverter switching is represented in detail.

1407 Solar Thermal Power Systems

42934 (N—88-20361) Solar dynamic power system definition study. Final report. Wallin, W.E.; Friefeld, J.M. (Rockwell International Corp., Canoga Park, CA (USA)). Mar 1988. 322p. (NASA-CR—180877; NAS—1.26:180877; RI/RD—87-250; CONF-870575—). NTIS, PC A14/MF A01.

From 39. National Aerospace and Electronics (NAECON) conference; Dayton, OH, USA (18 May 1987).

The solar dynamic power system design and analysis study compared Brayton, alkali-metal Rankine, and free-piston Stirling cycles with silicon planar and GaAs concentrator photovoltaic power systems for application to missions beyond the Phase 2 Space Station level of technology for all power systems. Conceptual designs for Brayton and Stirling power systems were developed for 35 kWe and 7 kWe power levels. All power systems were designed for 7-year end-of-life conditions in low Earth orbit. LiF was selected for thermal energy storage for the solar dynamic systems. Results indicate that the Stirling cycle systems have the highest performance (lowest weight and area) followed by the Brayton cycle, with photovoltaic systems considerably lower in performance. For example, based on the performance assumptions used, the planar silicon power system weight was 55 to 75 percent higher than for the Stirling system. A technology program was developed to address areas wherein significant performance improvements could be realized relative to the current state-of-the-art as represented by Space Station. In addition, a preliminary evaluation of hardenability potential found that solar dynamic systems can be hardened beyond the hardness inherent in the conceptual designs of this study.

42935 (SAND—87-7108) Solar Total Energy Project: Summary report. (Georgia Power Co., Shenandoah (USA)). May 1988. Contract AC04-76DP00789. 92p. NTIS, PC A05/MF A01;1; GPO Dep. Order Number TI88012105/JAW.

The purpose of this summary is to present the Key Operational Experiences of the Georgia Power Company (GPC) team during its participation in the Solar Total Energy Project (STEP) from May, 1977, to the termination of the Department of Energy (DOE) Cooperative Agreement in September 1985. The original program between DOE and the GPC, and under the technical direction of Sandia National Laboratories (SNLA), was conceived to further the search for new sources of energy. STEP is continuing to supply valuable research data through support contracts from SNLA and funding from Electric Power Research Institute (EPRI) along with technical coordination with Solar Energy Research Institute (SERI) and other electric utilities and solar energy industries. The STEP is viewed as an absolute success as a concept demonstration and experimental facility. Although portions of the system were derated and the expected loads never developed, the overall systems worked well and continues to operate. Most of the problems encountered were solved. The technical achievement and lessons learned at STEP should be considered for use by other solar technologies in the national and international communities. 7 refs., 10 figs., 12 tabs.

42936 (SAND—88-1255C) Solar test of an integrated sodium reflux heat-pipe receiver/reactor for thermochemical energy transport. Diver, R.B.; Fish, J.D.; Levitan, R.; Levy, M.; Rosin, H.; Richardson, J.T. (Sandia National Labs., Albuquerque, NM (USA); Weizmann Inst. of Science, Rehovoth (Israel); Houston Univ., TX (USA). Dept. of Chemical Engineering). 1988. Contract AC04-76DP00789. 16p. (CONF-880655—6). NTIS, PC A03/MF A01; 1; GPO Dep. Order Number DE88012332/JAW.

From 4. international symposium on research, development and applications of solar thermal technology; Santa Fe, NM, USA (13 Jun 1988).

In October 1987, a chemical reactor integrated into a sodium reflux heat-pipe receiver was tested in the solar furnace at the Weizmann Institute of Science, Rehovot, Israel. The reaction carried out was the carbon dioxide reforming of methane. This reaction is one of the leading candidates for thermochemical energy transport either within a distributed solar receiver system or over long distances. The Schaeffer Solar Furnace consists of a 96 square meter heliostat and a 7.3 meter diameter dish concentrator with a 65-degree rim angle and a 3.5 meter focal length. Measurements have shown a peak concentration ratio of over 10,000 and a total power of 15 kW at an insolation of 800 w/square meter. The receiver/reactor contains seven catalyst-filled tubes inside an evacuated metal box containing sodium. The front surface of this box serves as the solar absorber of the receiver. In operation, concentrated sunlight heats the 1/8-inch Inconel plate and vaporizes sodium from the wire-mesh wick attached to the back of it. The sodium vapor condenses on the reactor tubes, releases its latent heat, and returns by gravity to the wick. Test results and areas for future development are discussed.

1409 Solar Thermal Utilization

REFER ALSO TO CITATION(S) 43303, 43398, 43406

42937 (DTH-LV—86-9) IEA project - Smakkebo. Documentation of design, construction, monitoring programme. Moerck, O.C. (Carlsberg Lab., Copenhagen (Denmark)). May 1986. 77p. NTIS (US Sales Only), PC A05/MF A01. Order Number DE88752084/JAW.

At a building site of approx 35000 m² situated in the village of Snekkersten close to Elsinore, 55 single family, solar low-energy dwellings and one common house have been erected during the period May 1984 to February 1985. This building project was built as the Danish contribution to Subtask D of Task VIII, Passive and Hybrid Solar Low Energy Dwellings of the IEA Solar Heating and Cooling R and D Programme. This report accounts for the background, the objectives, the design considerations, the construction and the monitoring programme of the project, generally known as the Danish IEA Project, Smakkebo, Following the completion of the monitoring phase, a final report presenting the results hereof will be published. This report is scheduled to the end of this year. The project comprises 4 different types of dwellings, A = 62 m², B = 78 m², C = 85 m² and C+ = 97 m² and a common house which consists of 2 type A houses in combination. The solar and energy conservation techniques applied are the same in all houses

except for the solar hot water system, which is only present in the B, C and C+ types.

42938 (DTH-LV-MEDD—178) Solar heating in new buildings. Moellgaard, M.; Oestergaard Jensen, S. (Danmarks Tekniske Hoejskole, Lyngby. Lab. for Varmeisolering). Mar 1987. 62p. (In Danish). NTIS (US Sales Only), PC A04/MF A01. Order Number DE88752079/JAW.

Energiministeriets Solvarmeprogram. Rapport, 39.

In this report the problems concerning solar heating systems for new buildings - both construction and economy - are discussed. A comparison of the economy of solar heating systems for new buildings and solar heating systems installed in already existing heating systems is made. A presentation of various constructions of solar heating systems for heating of domestic hot water is made; and an example of a very cheap solar heating system, which is especially well suited for new buildings, is given. A combination of active and passive solar heating is also discussed. Finally some examples of solar heating systems built and studied within recent years are mentioned; the output and the economy of the systems are stated and new solutions are mentioned. 21 refs.

42939 (EEL—SIM7) Thermosyphon solar domestic hot water systems: development of a method of seasonal thermal performance prediction. Carpenter, S.C.; Chamberlain, M.J. (Enermodal Engineering Ltd., Waterloo, Ontario (Canada)). Aug 1983. 42p. (CE—01539). CANMET/TID, Energy, Mines and Resources Canada, 555 Booth St., Ottawa, Ont., Canada K1A 0G1; $0.34CAN per page, $3.40 CAN minimum.

A computer simulation program that predicts the seasonal thermal performance of thermosyphon domestic hot water systems was developed. This report summarizes the development of the simulation program and includes mathematical modelling assumptions applicable to the computer model. The program (SYPHON) has been documented elsewhere and written in interactive form to facilitate general use. It models water, glycol, and refrigerant loop systems. Comparison of simulted system performance to experimental results, reported in the literature, indicated good accuracy but further testing is required. 19 refs., 12 figs.

42940 (EMR/RE—051985) Understanding solar technology. (Department of Energy, Mines and Resources, Ottawa, Ontario (Canada). Renewable Energy Resources Branch). May 1985. 22p. (In French). (CE—01577). CANMET/TID, Energy, Mines and Resources Canada, 555 Booth St., Ottawa, Ont., Canada K1A 0G1; $0.34CAN per page, $3.40 CAN minimum.

This booklet contains descriptions of different kinds of solar hardware. First to be described are the systems: space heating systems, domestic hot water heating systems, pool heating systems, and solar greenhouses. Following are descriptions of the components of those systems: collectors and their support tracks, thermal storage units, handling units, heat exchangers, insulated windows and shutters, and photovoltaic panels. Next to be described are the parts and materials used within the components: collector glazings, absorbers and coating, gaskets, insulation, pumps, monitors and controls, phase-change materials, etc. Systems are also described as being either liquid or air systems, depending on which fluid is used to gather and distribute the heat. For the most part, the circulation and distribution components of liquid solar heating systems are assembled from standard plumbing parts that can be purchased from most hardware or plumbing supply stores. For air solar heating systems, many of the specialized parts required for the circulation and distribution system are standard items in the heating, ventilating and air conditioning industry. This applies to such items as ducting, back-flow dampers, motorized dampers, and variable-speed blowers. 33 figs.

42941 (GB—133) Using energy from the sun: solar energy technology in Britain. (Department of Energy, London (UK)). Feb 1988. 14p. NTIS (US Sales Only), PC A03/MF A01. Order Number DE88753397/JAW.

The UK Department of Energy research and development programme in solar energy is described. It has been shown that making direct use of the sun's energy through passive solar design in buildings is one of the most economically attractive ways of using renewable energy in Britain. Combined with energy efficiency measures, passive solar design can reduce energy consumption by as much as 50 per cent in housing and lead to substantial energy savings in commercial buildings. Examples of passive solar design include large south facing windows and small north facing areas, a highly glazed unheated room on the south side of a house, trombe walls, perimeter and core daylighting systems in large commercial buildings. By contrast, the R and D programme has demonstrated that active solar technology using heat collectors and a transfer fluid are unlikely to be cost effective in British climatic conditions except for special applications such as swimming pools. Photovoltaic systems were abandoned early in the programme as offering little prospect of making an economic contribution to UK energy supplies.

42942 (LBL—25060) Approach for evaluating the thermal comfort effects of nonresidential building fenestration systems. Sullivan, R.; Arasteh, D.; Papamichael, K.; Selkowitz, S. (Lawrence Berkeley Lab., CA (USA)). Mar 1988. Contract AC03-76SF00098. 11p. (CONF-8805151—1). NTIS, PC A03/MF A01; 1; GPO Dep. Order Number DE88011961/JAW.

From International symposium on advanced comfort systems for the work environment; Troy, NY, USA (1 May 1988).

This paper documents an approach for evaluating the comfort impacts associated with varying fenestration system parameters primarily under the influence of direct solar radiation. The authors present a method of evaluation in which it was shown that an annual comfort index could be determined by knowing the fenestration system solar heat gain coefficient and aperture size.

42943 (NRC/BR—184) Utilization of solar gain through windows for heating houses. Barakat, S.A.; Sander, D.M. (National Research Council of Canada, Ottawa, Ontario. Div. of Building Research). Mar 1982. 19p. (CE—01587). CANMET/TID, Energy, Mines and Resources Canada, 555 Booth St., Ottawa, Ont., Canada K1A 0G1; $0.34CAN per page, $3.40 CAN minimum.

The heating energy requirements for houses may be estimated by a simple calculation using the concept of a seasonal solar utilization factor. Solar utilization factors were derived using an hour-by-hour computer simulation with actual weather data for five Canadian locations. These utilization fators are presented for various levels of thermal storage as a function of the ratio of seasonal solar gains to seasonal building loads. Curves are presented both for conditions of constant room temperature and for temperature swings of 2.75/sup 0/ and 5.5/sup 0/C. Experimental data obtained from the National Research Council Passive Solar Test Facility are shown to agree with calculations using the utilization factors. 12 refs., 12 figs., 2 tabs.

42944 (NRC/BR—188) Passive solar heating studies at the Division of Building Research. Building Research Note, No. 188. Barakat, S.A. (National Research Council of Canada, Ottawa, Ontario. Div. of Building Research). May 1982. 10p. (CE—01586). CANMET/TID, Energy, Mines and Resources Canada, 555 Booth St., Ottawa, Ont., Canada K1A 0G1; $0.34CAN per page, $3.40 CAN minimum.

As part of the program of the National Research Council of Canada to evaluate passive solar heating techniques, a test facility was constructed at the Division of Building Research (DBR) to obtain data on the thermal performance of passively heated structures and to develop simple calculation procedures and guidelines for designing houses with passive features. This Note gives the construction features and instrumentation details of the passive solar test facility and describes the studies being undertaken at DBR related to passive solar heating. These include evaluation of heating techniques, study of the dynamic thermal response of houses, study of solar gain through windows, and development of design guidelines and calculation procedures. 5 refs., 3 figs., 1 tab.

42945 **(NRC/E—1978) NRC [National Research Council] Solar Information Series. Solar heated homes in Canada. Solar Information Series, 1.** (National Research Council of Canada, Ottawa, Ontario. Div. of Energy). 1978. 246p. (EN;FR). (CE—01623). CANMET/TID, Energy, Mines and Resources Canada, 555 Booth St., Ottawa, Ont., Canada K1A 0G1; $0.34CAN per page, $3.40 CAN minimum.

This booklet describes fourteen houses in Canada which have been constructed or retrofitted with solar heating systems. These houses were used to test a variety of systems as part of Canada's solar research activity. Basic principles of solar heating systems and solar collectors are also described, along with supplementary heating and heat storage devices. 25 figs., 1 tab.

42946 **(NUCLEBRAS-CDTN—587) Modelling and analysis of a heating system for industrial application, using flat-plate solar-collectors with single and double cover glasses.** Maraslis, A.A. (Centro de Desenvolvimento da Tecnologia Nuclear, Belo Horizonte (Brazil)). 1987. 149p. (In Portuguese). NTIS (US Sales Only), PC A07/MF A01. Order Number DE88702615/JAW.

A calculational methodology for dimensioning a flat-plate solar-collector arrangement, which fulfils the energy requirement of a heat transfer system in one of the steps of the uranium recovery process, from the uranium-phosphorus ore at Itataia, Ceara, in Brazil. The PROSOL-1 and PROSOL-2 computer codes for determining the total area required by collector arrangement-with single and double cover glasses, respectively- taking into account the system design and meteorological conditions of the regions, were used. These codes optimize the series/parallel arranges of collectors in the whole complex and, determine the water flow in each system and the average efficiency of the collector arrangement. The technical and economical feasibility for both collector arrangement with single and double cover glasses, were verified. It was concluded that, the last one is more advantageous, allowing a reduction of 30% in the total collector area. (M.C.K.).

42947 (NUSE—8501, pp 35-38) **Development of technique for distillation/refining of waste organic solvent using solar energy (Part 1).** Ishii, Masamichi; Asai, Katsuichi; Komori, Naohira. (Nagoya Univ., Faculty of Engineering, Nagoya, Japan). Feb 1985. (In Japanese). Nagoya Univ., Research Center for Resource and Energy Conservation. Furo-cho, Chikusa-ku, Nagoya.

In FY 1982-1983 Report of Nagoya Univ., Research Center for Resource and Energy Conservation.

A non-boiling type distillation equipment that operates on solar energy is designed and produced. With this equipment, a waste organic solvent recovery/refining system which can serve for saving energy and labor is developed. First, a commercial solar water-heater manufactured by Sekisui Chemical Co., Ltd. is used to produce a reduced-pressure, non-boiling type water distillation apparatus, and then a similar apparatus for chloroform is fabricated. The design of this apparatus is characterized by an appropriate volume of air provides as a pressure buffer at the top of the distillation apparatus and condenser, a suitable shape of air-cooled condenser made of glass, control of the distillation pressure by changing the potential energy, and use of generated vapor for automatic control of the liquid level. (5 figs, 2 photos)

42948 (NUSE—8501, pp 39-42) **Development of technique for distillation/refining of waste organic solvent using solar energy (Part 2).** Ishii, Masamichi; Asai, Katsuichi; Komori, Naohira. (Nagoya Univ., Faculty of Engineering, Nagoya, Japan). Feb 1985. (In Japanese). Nagoya Univ., Research Center for Resource and Energy Conservation. Furo-cho, Chikusa-ku, Nagoya.

In FY 1982-1983 Report of Nagoya Univ., Research Center for Resource and Energy Conservation.

To perform production of distilled water and distillation/refining of organic solvents, a laboratory apparatus was developed which uses solar heat alone instead of conventional electric heating. The solar-heat distillation apparatus fabricated was operated in summer, with the lower part of the solar heat collector being covered with a screen to ensure that reduced-pressure, non-boiling distillation would be performed stably at high temperatures. Another specially-designed solar heat collector consisting of heat pipes was used to develope a reduced-pressure distillation apparatus equipped with a hot water tank for heat storage. Steam generated in this apparatus is air-cooled by a fan that operates on a solar battery to produce distilled water efficiently. Furthermore, another method is developed in which the latent heat of vaporization of organic solvents, instead of air, is utilized for the cooling process. In this distillation/refining method, an organic solvent is boiled in a condenser and generated vapor is condensed by air-cooling. A practical system is fabricated by combining the above two processes. (6 figs, 2 photos)

42949 (NUSE—8601, pp 190-191) **Basic study on design of destilling water plant utilizing solar heat.** Asai, Katsuichi; Komori, Kinpei. (Nagoya Univ., Nagoya, Japan). Feb 1986. (In Japanese). Nagoya University, Nagoya, Japan.

In FY 1984 Report of Nagoya Univ., Research Center for Resource and Energy Conservation.

In order to desin an efficient service model of the distilled water producing device with a solar heat hot water supplier available in the market as an evaporator, a system fulfilling the following four items was studied and the ideal conditions were discovered: 1) To plan the effective utilization of heat by reducing the distillation residue which fails to become vapor and remains in the evaporator. 2) To design the device so that the distillation residue may easily be extracted every day. 3) To minimize the reflux of vapor to the original water. 4) Since no energy is totally used except the solar heat, the movement of the original water is made not by pump, but by gravity and natural convection with the temperature gradient in the hot water tank as the motive power. In conclusion, the inner diameter of the vapor-liquid column should be about 15mm and the column be set preferably as vertical as possible. The volume of the hot water storage tank should be balanced with the capacity of the evaporator, the volume of the space and the water surface area should both be as small as possible, the water level should remain constant and the water surface temperature should be 80°C or more. The water head should be about 60cm. The vapor tube should be of the type of not going through the hot water storage tank and be vertical with the inner diameter of 20mm like the inner tube of the heat exchanger. (16 figs)

42950 **Neutral planes in stratified, thermally driven multiple-room enclosures.** Otis, D.R. (Univ. of Wisconsin, Madison (USA)). *Solar Energy;* **40**: No. 2, 135-137(1988).

When an opening connects two rooms, the neutral plane is the vertical location in the opening at which no air exchange between the rooms occurs. The neutral plane is widely used in modeling and data analysis for predicting thermal performance of buildings but, when more than one occurs, determining their locations has in the past been muddled with algebraic complexity. The necessary and sufficient conditions for the existence of multiple neutral planes as defined and a simple geometric method to locate them relative to each other is provided.

1410 Solar Collectors And Concentrators

42951 **(DTH-LV—86-3) Moisture in solar collectors.** Svendsen, S. (Danmarks Tekniske Hoejskole, Lyngby. Lab. for Varmeisolering). Apr 1986. 49p. NTIS (US Sales Only), PC A03/MF A01. Order Number DE88752087/JAW.

The basic problems with condensation in solar collectors are discussed. A model of how condensation takes place in collectors is set up. A computer program based on the model is written and some preliminary results are presented. The validation is not carried out but the principles for this work is discussed. It has been showed that it is possible to establish a model of how condensation takes place in solar collectors. The ventilation rate curve or number for the collector is used as the major parameter. Based on some preliminary results it looks likely that it will be possible to find an optimum ventilation rate curve for collectors. More work has to be done on the validation of the model and the program. The maximum amount of water that can stay on the outside and the inside of the cover without running off has to be found from measurements. (SM).

42952 **(DTH-LV—86-4) Reliability tests of solar collectors.** Svendsen, S. (Danmarks Tekniske Hoejskole, Lyngby. Lab. for Varmeisolering). Apr 1986. 35p. NTIS (US Sales Only), PC A03/MF A01. Order Number DE88752086/JAW.

The work within this contract on reliability tests are split into an experimental part and a part on setting up test procedures. The experimental part is concentrated on pressure and leak tests of metallic absorbers and plastic absorbers. Also work on hail and wind load tests of covers is included. An evaluation of these tests are made with the conclusion that the tests are useful and easy to carry out. The work on setting up procedures includes discussion and formulating the test procedures to be used to tst the collectors with respect to Internal pressure og absorber, High temperature stagnation, External thermal shock and Rain penetration.

42953 **(ORF—10091975) The establishment of a test facility for solar collector panels.** Norgate, C. (Ontario Research Foundation, Sheridan Park (Canada)). 10 Sep 1975. 27p. (CE—01615). CANMET/TID, Energy, Mines and Resources Canada, 555 Booth St., Ottawa, Ont., Canada K1A 0G1; $0.34CAN per page, $3.40 CAN minimum.

One of the conponents of a solar heating system is the solar collector, which is perhaps the most specialized component and one which offers the most scope for technological improvement, particularly with regard to cost. It is proposed that a contract be awarded to the Ontario Research Foundation to design and build a comprehensive test facility for solar collectors, eventually to be operated as a service with users paying the operating cost. Using the proposed facility it would be possible to monitor a number of collectors simultaneously over extended periods of time to determine optimum operating conditions, efficiency according to agreed standards, and durability with respect to environmental conditions and, where liquid heat transfer media are used, corrosion. The facility will also enable measurements to be made which will indicate possible design improvements Specific technical proposals made in this document are as follows. An outdoor facility will be built for measuring the performance of up to 4 solar collectors simultaneously. This will comprise adjustable support frames, storage tanks for heat transfer liquid, plus associated hardware and instrumentation. The measuring equipment will be used to evaluate a number of solar collector assemblies currently of interest to Canadian users purchased or borrowed from suppliers. Laboratory measurements will be made to determine corrosion rates of materials commonly used for solar collectors. Equipment and methods for monitoring corrosion rates during performance testing will be developed. Equipment and methods will be developed for measuring the optical properties of cover plates and absorber furnaces. The work will be carried out by personnel from two ORF departments. Cost estimates are included. 2 refs., 4 figs., 1 tab.

42954 **Evaluating the economic advantage of two-stage tandem solar concentrators.** O'Gallagher, J.J.; Winston, R. (Univ. of Chicago, IL (USA)). *Solar Energy;* **40**: No. 2, 177-179(1988).

A model for the performance of two stage point focus concentrators for solar thermal applications was developed and the results used to estimate possible cost benefits associated with some particular examples of such designs. The analysis shows that significant performance gains result from the use of a secondary over a wide range of parameter values, generally in good agreement with the results of some broader studies currently being carried out. However, the cost benefit which is reported is relatively marginal. This inconsistency between cost and performance measures of benefit is puzzling but can be shown to be a consequence of the particular economic model. Improved performance should be an equally valid measure of relative benefit and is much easier to model and interpret. These points are quantitatively addressed.

15 GEOTHERMAL ENERGY

42955 **(GB—132) Drawing heat from the earth: geothermal energy technology in Britain.** (Department of Energy, London (UK)). Feb 1988. 14p. NTIS (US Sales Only), PC A03/MF A01. Order Number DE88753396/JAW.

The UK Department of Energy's geothermal energy research and development programme is described. In the UK, the only potential for commercially exploiting geothermal energy has been identified as lying in the creation of very deep, man made, steam producing reservoirs in the hot dry rock (HDR) granite formations found in a number of areas. Consequently the R and D programme is now concentrated on HDR technology. The main research project in Cornwall includes resource evaluation, seismic surveying, drilling and logging techniques and equipment, instrumentation and computer modelling. An underlying research programme at various centres aims to support the Cornish project and to investigate wider issues relating to the development and exploitation of HDR technology.

1501 Resource Status And Assessment

42956 **(DOE/ID/12546—1) New Mexico statewide geothermal energy program. Final technical report.** Icerman, L.; Parker, S.K. (ed.). (New Mexico Research and Development Inst., Santa Fe (USA)). Apr 1988. Contract FG07-84ID12546. 231p. NTIS, PC A 11; 3; GPO Dep. Order Number DE88012417/JAW.

This report summarizes the results of geothermal energy resource assessment work conducted by the New Mexico Statewide Geothermal Energy Program during the period September 7, 1984, through February 29, 1988, under the sponsorship of the US Dept. of Energy and the State of New Mexico Research and Development Institute. The research program was administered by the New Mexico Research and Development Institute and was conducted by professional staff members at New Mexico State University and Lightning Dock Geothermal, Inc. The report is divided into four chapters, which correspond to the principal tasks delineated in the above grant. This work extends the knowledge of the geothermal energy resource base in southern New Mexico with the potential for commercial applications.

42957 **(KUGP—59460041) Study on geothermal water circulation process in the geothermal area.** Yusa, Yuki. (Kyoto Univ. (Japan). Faculty of Science). Mar 1987. 90p. (In Japanese). Kyoto Univ., Japan.

Existence of a two-phase flow which accompanies a phase change in the flow behavior of the geothermal fluid which maintains the geothermal phenomena is very important. However, its basic characteristics are not yet sufficiently made. In this report, a strict and basic equation of the two-phase flow in the earth formations is introduced and its hydraulic characteristics were studied. Other subjects dealt in this report are as follows: Possibility of geothermal area formation by a large scale water circulation. Data of observation of gas blow and boiling springs in Beppu geothermal area. Approximate equation for the miscellaneous physical quantities of saturated water and saturated steam. Vertical circulation of two-phase geothermal fluid. (39 figs, 8 tabs)

1502 Geology And Hydrology Of Geothermal Systems

REFER ALSO TO CITATION(S) 42957

42958 **Valles caldera region, New Mexico, and the emerging continental scientific drilling program.** Goff, F.; Gardner, J.N. (Earth and Space Sciences Division, Los Alamos National Laboratory, Los Alamos, New Mexico). *Journal of Geophysical Research;* **93**: No. B6, 5997-5999(10 Jun 1988).

Valles caldera is best known in recent years as an excellent example of a resurgent caldera and as the site of a high-temperature geothermal system. However, Valles caldera and the surrounding Jemez Mountains volcanic field possess a rich history of geologic research that dates back to the late 1880s. Through the years, the research focus has changed as different economic and scientific factors have exerted their influence. Early work emphasized mining activity, while modern work has stressed volcanology and, later, geothermal development. Only in the last 5 years has it been possible to view the region as a dynamic, integrated magma-hydrothermal system having a complex evolution lasting more than 13 m.y.

42959 **Hydrothermal outflow plume of Valles caldera, New Mexico, and a comparison with other outflow plumes.** Goff, F.; Shevenell, L.; Gardner, J.N.; Vuataz, F.; Grigsby, C.O. (Los Alamos National Laboratory, New Mexico). *Journal of Geophysical Research;* **93**: No. B6, 6041-6058(10 Jun 1988).

Stratigraphic, temperature gradient, hydrogeochemical, and hydrologic data have been integrated with geologic data from previous studies to show the structural configuration of the Valles caldera hydrothermal outflow plume. Hydrologic data suggest that 25—50% of the discharge of the Valles outflow is confined to the Jemez fault zone, which predates caldera formation. Thermal gradient data from bores penetrating the plume show that shallow gradients are highest in the vicinity of the Jemez fault zone (up to 190 °C/km). Shallow heat flow above the hydrothermal plume is as high as 500 mW m^{-2} near core hole VC-1 (Jemez fault zone) to 200 mW m^{-2} at Fenton Hill (Jemez Plateau). Chemical and isotopic data indicate that two source reservoirs within the caldera (Redondo Creek and Sulphur Springs reservoirs) are parents to mixed fluids flowing in the hydrothermal plume. However, isotopic data, borehole data, basic geology, and inverse relations between temperature and chloride content at major hot springs indicate that no single reservoir fluid and no single diluting fluid are involved in mixing. The Valles caldera hydrothermal plume is structurally dominated by lateral flow through a belt of vertical conduits (Jemez fault zone) that strike away from the source reservoir. Stratigraphically confined flow is present but dispersed over a wide area in relatively impermeable rocks. The Valles configuration is contrasted with the configuration of the hydrothermal plume at Roosevelt Hot Springs, which is dominated by lateral flow through a near-surface, widespread, permeable aquifer. Data from 12 other representative geothermal systems show that outflow plumes occur in a variety of magmatic and tectonic settings, have varying reservoir compositions, and have different flow characteristics.

42960 **Strontium isotope study of the VC-1 core hole and associated hydrothermal fluids and rocks from Valles caldera, Jemez Mountains, New Mexico.** Vuataz, F.; Goff, F.; Fouillac, C.; Calvez, J. (Institut Mixte de Recherches Gel;aothermiques, Bureau de Recherches Geologiques et Minieres, Orleans, France). *Journal of Geophysical Research;* **93**: No. B6, 6059-6067(10 Jun 1988).

Chemical and strontium isotopic analyses have been performed on 10 geothermal waters from the Valles caldera/Jemez Mountain region, as well as 10 rock samples collected in the VC-1 scientific core hole. The /sup 87/Sr//sup 86/Sr values of other rocks sampled in the Jemez Mountains have also been used in this study to understand relations between the fluids and rocks of the volcanically driven geothermal system and the lateral outflow plume, discharging down the Jemez fault zone. The strontium content of ground-water is linked to the host rock composition, the aquifer temperature, and therefore the solubility of Sr-containing minerals. Low Sr concentrations in the fluid are found with a high temperature and/or volcanic host rocks, whereas high Sr concentrations are characteristic of a low temperature and/or a Paloezoic sedimentary aquifer. Important variations of the /sup 87/Sr//sup 86/Sr value in hydrothermal waters (0.70842—0.72193) are related to chemical composition, Sr content, and host rocks. For VC-1 core samples, the Sr isotopic ratios are also markedly variable (0.70459—0.75686), low for the Quaternary volcanics and high for the Paleozoic sedimentary rocks. The same observation is made for other Jemez Mountains rocks (0.70465—0.8163) with, in addition, high /sup 87/Sr//sup 86/Sr values for Precambrian crystalline rocks. A good correspondence is generally found between the waters and the reservoir rocks studied here, which indicates that isotopic equilibrium is rapidly attained. The following suite of hydraulically related fluids displays a progressive enrichment in radiogenic strontium: Baca wells (/sup 87/Sr—/sup 86/Sr = 0.7084—0.7094), VC-1 core hole at 483 m (0.7152—0.7154), Main Jemez Spring (0.7217), and Soda Dam (0.7219).

42961 **State of stress and relationship of mechanical properties to hydrothermal alteration at Valles caldera core hole 1, New Mexico.** Dey, T.N.; Kranz, R.L. (Earth and Space Sciences Division, Geophysics Group, Los Alamos, National Laboratory, New Mexico). *Journal of Geophysical Research;* **93**: No. B6, 6108-6112(10 Jun 1988).

We measured the densities, total and microcrack porosities, and ultrasonic velocities of a number of core samples from an 856-m-deep core hole near the Banco Bonito vent at Valles Caldera, New Mexico. Reductions in porosity with depth define a zone from about 600 m down where hydrothermal mineralization and recrystallization have been most active. This zone is also reflected in a large decrease in the anisotropy of acoustic velocities. Stress orientation estimates based on microcrack orientations at the 812-m depth as determined by differential strain curve analysis, as well as anelastic strain recovery measurements on a sample from 472-m depth, show a horizontal E-W minimum compression direction and a maximum compression inclined about 30° from vertical.

1503 Geothermal Exploration And Exploration Technology

REFER ALSO TO CITATION(S) 42964

1505 Economic And Financial Aspects

42962 **(DOE/CE/31010—T1) Geothermal energy technology: issues, R & D needs, and cooperative arrangements.** (National Research Council, Washington, DC (USA). Commission on Engineering and Technical Systems). 1987. Contract FG01-86CE31010. 106p. NTIS, PC A06/MF A01; 1; GPO Dep. Order Number DE88011804/JAW.

In 1986, the National Research Council, through its Energy Engineering Board, formed the Committee on Geothermal Energy Technology. The committee's study addressed major issues in geothermal energy technology, made recommendations for research and development, and considered cooperative arrangements among government, industry, and universities to facilitate R&D under current severe budget constraints. The report addresses four types of geothermal energy: hydrothermal, geopressured, hot dry rock, and magma systems. Hydrothermal systems are the only type that are now economically competitive commercially. Further technology development by the Department of Energy could make the uneconomical hydrothermal resources commercially attractive to the industry. The economics are more uncertain for the longer-term technologies for extracting energy from geopressured, hot dry rock, and magma systems. For some sites, the cost of energy derived from geopressured and hot dry rock systems is projected within a commercially competitive range. The use of magma energy is too far in the future to make reasonable economic calculations.

1506 Environmental Aspects And Waste Disposal

REFER ALSO TO CITATION(S) 42691

1508 Geothermal Power Plants

42963 **(DOE/ID/12490—1-Vol.2) Hydrothermal energy extraction, Auburn, New York: Final report: Volume 2, Chapters 6-10.** Castor, T.P. (ENG, Inc., Cambridge, MA (USA)). Mar 1988. Contract FG07-83ID12490. 203p. NTIS, PC A10/MF A01; 3; GPO Dep. Order Number DE88011289/JAW.

This paper discusses a hydrothermal energy extraction system in detail. General topics covered are: Reservoir circulation loop; HVAC buffer loop; and automatic temperature control system. (LSP)

42964 **(DOE/ID/12490—1-Vol.3) Hydrothermal energy extraction, Auburn, New York: Final report: Volume 3, Appendices.** Castor, T.P. (ENG, Inc., Cambridge, MA (USA)). Mar 1988. Contract FG07-83ID12490. 225p. NTIS, PC A10. Order Number DE88011290/JAW.

This paper contains detailed information on hydrothermal energy extraction systems. Topics covered in appendices are: location, floor areas, estimated heat loss, and equipment types of the main building of Cayuga County Community College; mineral analysis and photomicrograph of fines from the Auburn geothermal

well No. 2; underground injection control permit of the Auburn geothermal well No. 2; injectivity enhancement of Auburn geothermal well No. 2; chemical analysis of brine from the Auburn geothermal well No. 2; analysis of natural gas taken from the annulus of the Auburn geothermal well No. 2; specification of antisealant flocon 100; and listing of customized software for the hydrothermal energy extraction plant, Auburn, New York. (LSP)

1509 Geothermal Engineering

REFER ALSO TO CITATION(S) 42691

42965 (SGP-TR—110) Injection through fractures. Johns, R.A. (Stanford Univ., CA (USA). Stanford Geothermal Program). May 1987. Contract AS07-84ID12529. 177p. NTIS, PC A09/MF A01; 1; GPO Dep. Order Number DE88012262/JAW.

Tracer tests are conducted in geothermal reservoirs as an aid in forecasting thermal breakthrough of reinjection water. To interpret tracer tests, mathematical models have been developed based on the various transport mechanisms in these highly fractured reservoirs. These tracer flow models have been applied to interpret field tests. The resulting matches between the model and field data were excellent and the model parameters were used to estimate reservoir properties. However, model fitting is an indirect process and the model's ability to estimate reservoir properties cannot be judged solely on the quality of the match between field data and model predictions. The model's accuracy in determining reservoir characteristics must be independently verified in a closely controlled environment. In this study, the closely controlled laboratory environment was chosen to test the validity and accuracy of tracer flow models developed specifically for flow in fractured rocks. The laboratory tracer tests were performed by flowing potassium iodide (KI) through artificially fractured core samples. The tracer test results were then analyzed with several models to determine which best fit the measured data. A Matrix Diffusion model was found to provide the best match of the tracer experiments. The core properties, as estimated by the Matrix Diffusion model parameters generated from the indirect matching process, were then determined. These calculated core parameters were compared to the measured core properties and were found to be in agreement. This verifies the use of the Matrix Diffusion flow model in estimating fracture widths from tracer tests.

42966 (SGP-TR—111) Decline curve derivative analysis for homogeneous and composite reservoirs. Demski, J.A. (Stanford Univ., CA (USA). Stanford Geothermal Program). Jun 1987. Contract AS03-80SF11459. 42p. NTIS, PC A03/MF A01; 1; GPO Dep. Order Number DE88012259/JAW.

In this study, the rate decline and rate decline derivatives of a constant pressure well are presented for infinite, constant pressure outer boundary, and closed outer boundary homogeneous reservoirs. A rate derivative type curve is provided for these cases as well. The effects of the dimensionless reservoir exterior radius are discussed. Rate decline and rate decline derivatives of a constant pressure well in an infinite composite reservoir are also presented. For composite reservoirs, the effects of mobility ratios and discontinuity distance on both rate decline and rate decline derivatives are presented. Type curves for dimensionless wellbore flow rate derivatives for infinite composite reservoirs are provided. A new correlating group for the derivative type curve is provided, and is different than the correlating group for the rate type curve presented in the past. Finally, an analysis method that comprises type curve and derivative type curve matching to determine the dimensionless variables is proposed and demonstrated with a simulated example.

42967 (SGP-TR—112) Optimization of injection scheduling in geothermal fields. Lovekin, J. (Stanford Univ., CA (USA). Stanford Geothermal Program). May 1987. Contract AS03-80SF11459;AS07-84ID12529. 181p. NTIS, PC A09/MF A01; 1; GPO Dep. Order Number DE88012260/JAW.

This study discusses the application of algorithms developed in Operations Research to the optimization of brine reinjection in geothermal fields. The injection optimization problem is broken into two sub-problems: (1) choosing a configuration of injectors from an existing set of wells, and (2) allocating a total specified injection rate among chosen injectors. The allocation problem is solved first. The reservoir is idealized as a network of channels or arcs directly connecting each pair of wells in the field. Each arc in the network is considered to have some potential for thermal breakthrough. This potential is quantified by an arc-specific breakthrough index, b/sub ij/, based on user-specified parameters from tracer tests, field geometry, and operating considerations. The sum of b/sub ij/-values for all arcs is defined as the fieldwide breakthrough index, B. Injection is optimized by choosing injection wells and rates so as to minimize B subject to constraints on the number of injectors and the total amount of fluid to be produced and reinjected. The study presents four computer programs which employ linear or quadratic programming to solve the allocation problem. In addition, a program is presented which solves the injector configuration problem by a combination of enumeration and quadratic programming. The use of the various programs is demonstrated with reference both to hypothetical data and an actual data set from the Wairakei Geothermal Field in New Zealand.

42968 (SGP-TR—114) Reservoir and injection technology: Geothermal reservoir engineering research at Stanford: Third annual report for the period October 1, 1986 through September 30, 1987: [Final report]. Ramey, H.J. Jr.; Horne, R.N.; Miller, F.G.; Brigham, W.E. (Stanford Univ., CA (USA). Stanford Geothermal Program). Feb 1988. Contract AS03-80SF11459. 142p. NTIS, PC A07/MF A01; 1; GPO Dep. Order Number DE88012679/JAW.

This paper discusses different aspects of geothermal reservoir engineering. General topics covered are: reinjection technology, reservoir technology, and heat extraction. (LSP)

1510 Direct Energy Utilization

REFER ALSO TO CITATION(S) 42919

16 TIDAL AND WAVE POWER

1607 Tidal Power Plants

42969 (CRIE-U—86033) Survey on utility technology of a tidal and ocean current energy. Hirose, Manabu; Kadoyu, Masataka; Tanaka, Hiroyoshi. (Central Research Inst. of Electric Power Industry, Tokyo (Japan)). Jun 1987. 68p. (In Japanese). NTIS (US Sales Only), PC A04. Order Number DE88770148/JAW.

A study is made to show the current technological levels in Japan and other nations regarding the conversion of tidal current or ocean current energy to electric power and to determine the latent energy quantities and energy-related characteristics of tidal and ocean currents. In Japan, relatively large-scale experiments made so far mostly used one of the following three types of devices: Savonius-wheel type, Darrieus-wheel type, and cross-flow-wheel type. field experiments of tidal energy conversion have been performed at the Naruto Straits and Kurushima Straits. The energy in the Kuroshio current is estimated at about 170 billion kWh per year. Ocean current energy does not undergo large seasonal variations. The total energy in major straits and channels in the Inland Sea and other sea areas to the west is estimated at about 124 billion kWh per year. Tidal current energy shows large seasonal variations, but it is possible to predict the changes. A survey is made to determine energy-related characteristics of a tidal current at Chichino-seto, Kagoshima Prefecture. At Chichino-seto, the flow velocity ranges from zero to 2.2m/s, with a latent tidal current energy of about 70 kW. It is estimated that 20 kW of it can be actually utilized. (36 figs, 4 tabs, 3 photos, 27 refs)

1608 Wave Energy Converters

42970 **(ETSU-WV—1503-Pt.1) Salter duck device feasibility study.** (UKAEA Harwell Lab. Energy Technology Div.; Sea Energy Associates Ltd., Feltham (UK)). Jun 1978. 34p. British Library Document Supply Centre, Boston Spa, Wetherby, West Yorks. LS23 7BQ.

The feasibility of construction of wave energy power absorption units, in the U.K. was studied. The investigation covered the selection of optimum construction methods, the effect on costs if production were to be guaranteed over a number of years and the feasibility of developing a mechanism for converting oscillatory motion into a form of energy suitable for power generation having a virtually maintenance-free life of ten years whilst operating continuously in a sea water environment.

42971 **(ETSU-WV—1507-Pt.1) Progress note on improving directional resolution of wave data.** Gedling, P. (UKAEA Harwell Lab. Energy Technology Div.). Aug 1978. 58p. British Library Document Supply Centre, Boston Spa, Wetherby, West Yorks. LS23 7BQ.

Waves on Loch Ness have been monitored by an array of seven arbitrarily spaced capacitance probe wave-height sensors. Computer analysis of the data has been carried out using the maximum likelihood method to produce high resolution directional wave-energy spectra for a range of frequencies. The development and application of a computer simulated wave field indicates modifications to the array which will improve the resolution of subsequent data analyses.

42972 **(ETSU-WV—1507-Pt.2) Extraction of energy from water waves - an analytical approach.** Resat Ozkan, I. (UKAEA Harwell Lab. Energy Technology Div.). Jul 1980. 72p. British Library Document Supply Centre, Boston Spa, Wetherby, West Yorks. LS23 7BQ.

A theoretical approach to energy extraction from water waves by means of antisymmetric two-dimensional objects freely floating in or under the free-surface of a deep fluid is presented. The hydrodynamic boundary-value problem is formulated analytically, the numerical procedure for its evaluation is given and computer implementation described. The application of the calculations to a wave energy test device is outlined.

42973 **(ETSU-WV—1518-Pt.4) Wave energy programme feasibility study on a submerged resonant duct. Second report.** (UKAEA Harwell Lab. Energy Technology Div.; Vickers Ltd., Eastleigh (UK). Design and Projects Div.). Sep 1978. 79p. British Library Document Supply Centre, Boston Spa, Wetherby, West Yorks LS23 7BQ.

Wave tank experiments to study the resonant behaviour of oscillating water columns are described. Initial experiments, conducted with vertical cylindrical pipes with sharp edged downward facing inlets indicate that it is unlikely that optimum performance will be achieved at duct diameters greater than about 1/3 of a wavelength. The effect of adding a large bell mouth at the inlet approximately doubled the fluid displacement. Subsequent experiments have shown that significant levels of fluid power could be extracted by overtopping from an oscillating water column. The overall feasibility of the concept has been demonstrated in a fully submerged model.

42974 **(ETSU-WV—1533-Pt.1) Corrosion experiment off South Uist.** Picken, M.J.; Bowers, R. (UKAEA Harwell Lab. Energy Technology Div.). Dec 1981. 16p. British Library Document Supply Centre, Boston Spa, Wetherby, West Yorks. LS23 7BQ.

The results of a experiment to investigate the corrosion of mild steel in seawater in a wave energy area of the Outer Hebrides are reported. Cathodic protection of the steel specimen was effected using a zinc anode. Measurements of corrosion potential, corrosion current, water speed and water temperature were made. An equation linking the corrosion current, water speed and time of exposure has been derived.

42975 **(ETSU-WV—1551-Pt.18) Extraction of power from sea waves 1/150 scale model testing.** (UKAEA Harwell Lab. Energy Technology Div.; Wavepower Ltd., Southampton (UK)). Dec 1979. 20p. (WP—120). British Library Document Supply Centre, Boston Spa, Wetherby, West Yorks. LS23 7BQ.

A progress report is given for the R and D programme for wave energy conversion. Scale models (1/150th) were tested in two-and three-dimensional tanks and problems encountered are discussed. Tests were carried out both for a single raft and for a small array. Recommendations for further work are made and in particular the observed variations in performance for long and short crested random seas indicate the need for more information on likely real life locations.

42976 **(ETSU-WV—1551-Pt.20) Preliminary study for anchoring wave energy rafts.** Haak, R. van den. (Vrijhof Ankers B.V., Ijssel (Netherlands)). [1987]. 37p. British Library Document Supply Centre, Boston Spa, Wetherby, West Yorks LS23 7BQ.

The latest developments in anchor design are reviewed. A number of topics relating to anchor performance such as factors influencing penetration and holding power, strength and pretensioning are than considered. Whilst every available anchoring system has some disadvantages, the Hook anchor seems to be the best choice at present. Laying procedure and anchor handling is discussed in relation to wave energy projects. Preliminary indications of installation and production costs are given.

42977 **(ETSU-WV—1551-Pt.25) Engineering development of the Lancaster Flexible Bag and tube pump. A review of recent progress.** (UKAEA Harwell Lab. Energy Technology Div.; Wavepower Ltd., Southampton (UK)). Dec 1980. 10p. British Library Document Supply Centre, Boston Spa, Wetherby, West Yorks. LS23 7BQ.

A review of progress is given on the R and D programme associated with the wave energy conversion device known as the Lancaster Flexible Bag and its associated tube pump. The results of model tests on the hull structural loading in a wave tank are discussed. Practical engineering solutions have been found to earlier development obstacles. A computer program has been written to model the bag action and internal flow.

42978 **(ETSU-WV—1551-Pt.40) Power transmission study for a wave energy scheme based on Lancaster Flexible Bag devices. Supervisory and telecontrol system.** (UKAEA Harwell Lab. Energy Technology Div.; Wavepower Ltd., Southampton (UK)). Nov 1981. 21p. British Library Document Supply Centre, Boston Spa, Wetherby, West Yorks LS23 7BQ.

Consulting engineers: Preece, Cardew and Rider, Brighton (GB).

Various options are considered for power data transmission associated with the power collection and transmission system of a postulated wave energy conversion scheme off the Outer Hebrides. For data transmission between the off-shore and on-shore power collector stations a Power Line Carrier (PLC) system is judged to be most suitable. In the case of data transmission between power collector stations and the main control centre, a microwave/radio link is proposed as the amount of data does not lend itself to a PLC system. Cost estimates, in the main for equipment supply only, are given.

42979 **(ETSU-WV—1551-Pt.54) LFB mooring tests - June 1982.** (UKAEA Harwell Lab. Energy Technology Div.; Wavepower Ltd., Southampton (UK)). Sep 1982. 27p. (WP—155). British Library Document Supply Centre, Boston Spa, Wetherby, West Yorks. LS23 7BQ.

A progress report is given on the research programme associated with the wave energy conversion device known as the Lancaster Flexible Bag. Results are reported on the scale model tests with particular reference to the pattern of loading throughout the mooring lifetime. The results confirm earlier estimates of peak mooring forces.

42980 **(ETSU-WV—1551-Pt.56) Mass production of concrete spine hulls for the Lancaster Flexible Bag wave energy converter. Floating hull 1982 reference design. Final report.** (UKAEA Harwell Lab. Energy Technology Div.; Wavepower Ltd., Southampton (UK)). Sep 1982. 112p. British Library Document Supply Centre, Boston Spa, Wetherby, West Yorks. LS23 7BQ.

Drawings for floating hull reference design attached as separate annexe.

The establishment of a 2GW Wave Energy Station requires the building of a large number of hulls within 10 years. This implies production at an intensity and on a scale never before attempted with large concrete construction. A modular design geared for production with a carefully worked out factory process which can meet these output requirements is described. it is demonstrated that this can be achieved using, on the whole, well established technology although great emphasis must be given to preplanning all major operations and carefully matching design to production needs. Costings are set out which indicate that an initial investment of Pound 190 million will be needed in a dedicated construction facility, but this facility will be capable of producing 24 or 36 hulls per year, according to the number of production lines deployed, at a cost significantly lower than conventional costs.

42981 **(ETSU-WV—1555-Pt.2) Progress report on the triplate wave energy converter.** Altmann, H.; Farley, F.J.M. (UKAEA Harwell Lab. Energy Technology Div.). Nov 1979. 29p. British Library Document Supply Centre, Boston Spa, Wetherby, West Yorks LS23 7BQ.

Three vertical plates spaced $\lambda/4$ and $\lambda/2$ respond to the horizontal motion in the waves. The latter two plates have a fixed separation and remain almost stationary as a result of the half-wave resonance between them. The front plate moves to and fro, driving a double acting pump to produce hydraulic power. The device can give a good match to the incoming wave. Theoretical and experimental curves of efficiency vs wave period are presented for various plate depths and spacings. Forces in the system agree with theory for small waves, and have also been measured for large breaking waves. A method of limiting the structural forces in rough seas has been devised. A tentative full scale design is discussed.

42982 **(ETSU-WV—1555-Pt.4) Tri-plate wave energy converter. Preliminary design studies.** (UKAEA Harwell Lab. Energy Technology Div.; Royal Military Coll. of Science, Shrivenham (UK)). Dec 1979. 37p. British Library Document Supply Centre, Boston Spa, Wetherby, West Yorks. LS23 7BQ.

A report is given on the full scale viability of an experimental tri-plate wave energy converter. The characteristics of the mooring system are described since these affect the forces in the structure. Other topics covered include power take-off, maintenance and the possibility of using wind generators mounted on the stable reference platform. An estimate is made of the capital cost and suggestions for future work are outlined.

42983 **(ETSU-WV—1581-Pt.1) Reliability study of wave power devices. Phase 1 - initial appraisal.** (UKAEA Harwell Lab. Energy Technology Div.; Y-ARD Ltd., Glasgow (UK)). Jan 1980. 159p. (YR—2566/79). British Library Document Supply Centre, Boston Spa, Wetherby, West Yorks. LS23 7BQ.

This report concerns Phase 1 of a two phase Reliability Assessment of three wave power devices, the National Engineering Laboratory Oscillating Water Column, the French Flexible Bag and the Cockerell Raft. The initial assessment identifies sources of unreliability within each of the devices and discusses the viability of proceeding onto Phase 2 study work of a more detailed and probing nature. It concludes that the methodology exists for conducting cost effective qualitative and quantitative reliability analyses during Phase 2. A Reliability Programme Plan is proposed as a basis for undertaking these analyses. Difficulties which may be encountered are also identified.

42984 **(ETSU-WV—1581-Pt.1a) Reference design and preliminary FMEA for the Salter Duck wave energy device.** (UKAEA Harwell Lab. Energy Technology Div.; Y-ARD Ltd., Glasgow (UK)). Mar 1981. 34p. (YR—2566/79-App.7). British Library Document Supply Centre, Boston Spa, Wetherby, West Yorks. LS23 7BQ.

This appendix extends the work on wave power devices reported in YR.2566/79 to cover the Salter Duck. The initial assessment identifies sources of unreliability within the device and discusses the viability of proceeding to Phase 2 study work of a more detailed and probing nature. The conclusions of the work on other devices that the methodology exists for conducting cost-effective qualitative and quantitative reliability studies during Phase 2 are equally applicable to the Duck. Difficulties which may be encountered are also identified.

42985 **(ETSU-WV—1581-Pt.2) Reliability study of wave power devices. Phase 2 - availability assessment of the power generating plant on the French Flexible Bag.** (UKAEA Harwell Lab. Energy Technology Div.; Y-ARD Ltd., Glasgow (UK)). Jan 1980. 147p. (YM—3551/80). British Library Document Supply Centre, Boston Spa, Wetherby, West Yorks. LS23 7BQ.

This study examines the failure characteristics and potential corrective maintenance strategies to quantify the availability of the power plant on individual French Flexible Bag devices and for 40 MW device groups. It concludes that frequent corrective maintenance will be required in all seasons to achieve high output power levels comparable with land-based power stations. However, a less demanding maintenance strategy could be adopted with a 6% penalty on output. The dominant items, with respect to power loss and maintenance effort, are identified and bases established against which cost effective maintenance support and design change judgements can be made. It recommends that cost analyses of these aspects be undertaken and that certain fundamental assumptions be verified, prior to any decision to develop the design further.

42986 **(ETSU-WV—1582-Pt.2) Study of the operation and maintenance costs of a spine type of wave energy system.** Edwards, W.G.; Harmsworth, B.; Lillywhite, P.A. (UKAEA Harwell Lab. Energy Technology Div.; Easams Ltd., Camberley (UK)). Aug 1980. 132p. (EASAMS—2617/1). British Library Document Supply Centre, Boston Spa, Wetherby, West Yorks LS23 7BQ. Order Number DE88753399/JAW.

The operation and maintenance costs of a spine type of wave energy system have been assessed over a range of overhaul life. They are based on the Edinburgh Duck (1980 reference design) incorporating a gyro/flywheel power take-off, with compliance control and alternative power take-off at the spine joints. The complete system comprises 510 WEC units (or duck-pairs) moored in 100 m water depth. The working assumptions are a 2 GW rated system installed off the Hebrides, current technology hardware and maintenance equipment, and November 1979 prices and costing rates. None of the figures includes the substantial additional cost of replacing moorings, transmission cables or WEC losses, but the extra cost in the case of the spine device may be 50% of that for other moored devices.

42987 **(ETSU-WV—1586-Pt.1) Clam wave energy converter. Report for period July 1979 to December 1980.** (UKAEA Harwell Lab. Energy Technology Div.; Lanchester Polytechnic, Coventry (UK); Sea Energy Associates Ltd., Feltham (UK)). Feb 1981. 285p. British Library Document Supply Centre, Boston Spa, Wetherby, West Yorks LS23 7BQ.

Work by the Sea Energy Asociates Ltd - Lanchester Polytechnic Wave Energy Group on the Clam device since the April 1979 feasibility study has shown it to be a well developed and viable device capable of extracting energy economically from sea waves. The experience of the team includes mooring, structural and device tests from 1/100th to 1/10th scale in narrow and wide tanks, Draycote Reservoir and on Loch Ness. Theoretical and semi-empirical modelling has become increasingly important. Recently a test rig to assess a 1/10th scale power take off system, based on a

Wells turbine, has been completed. The philosophy of the project team has been to aim for a device as simple as possible, with a small number of moving parts in order to minimise maintenance problems.

42988 **(ETSU-WV—1587-Pt.2) Effect on fisheries of siting wave energy converters off the Buchan coast.** Lampitt, R.S. (UKAEA Harwell Lab. Energy Technology Div.). Jan 1980. 23p. British Library Document Supply Centre, Boston Spa, Wetherby, West Yorks LS23 7BQ.

Since 1976 the Department of Energy has been allocating funds for research and development of methods for extracting wave energy. It has been decided to deploy a line of wave energy converters (WEC) at 1/4 scale. This would consist of a 15km string of converters with gaps every 1km. One of the suggested sites for this line is off Peterhead in the Buchan district of north east Scotland. The effects that the scheme may have on the fisheries of that area are examined.

42989 **(ETSU-WV—1631-Pt.1) Assessment of wave power available at key United Kingdom sites.** Crabb, J.A. (UKAEA Harwell Lab. Energy Technology Div.). Dec 1983. 113p. British Library Document Supply Centre, Boston Spa, Wetherby, West Yorks LS23 7BQ.

A programme of wave measurements at key coastal sites off the United Kingdom is described and a summary of results given. From information on the vertical displacement of the sea surface obtained using Wavender buoys and shipborne waverecorders, estimates of overall power have been obtained. In order to make a full assessment of the available power, information on the directional distribution of power is necessary. In the absence of measured data, the directional properties of waves have been estimated from a consideration of the meteorological conditions. Extensive use has been made of results from the Meteorological Office wind-wave model.

42990 **(ETSU-WV—1633-Pt.1) Wave direction data offshore South Uist May-July 1983.** (UKAEA Harwell Lab. Energy Technology Div.). Jan 1984. 63p. British Library Document Supply Centre, Boston Spa, Wetherby, West Yorks. LS23 7BQ.

Wave direction data collected by a Marex Data Buoy deployed offshore in the Outer Hebrides are presented. Sensors on board the buoy measure vertical acceleration, pitch, roll, heading and time. The data are telemetered to a shore station. This report tabulates and discusses the data and gives details of the collection and processing operation.

42991 **(ETSU-WV—1638-Pt.1) Feasibility study on submerged oscillating water column wave energy devices. Progress report 1st July 1979 to 31st May 1980.** (UKAEA Harwell Lab. Energy Technology Div.; Vickers Ltd., Eastleigh (UK). Design and Projects Div.). Jun 1980. 140p. British Library Document Supply Centre, Boston Spa, Wetherby, West Yorks LS23 7BQ.

Studies of two new wave energy devices, the Submerged Wave Chamber and the Twin Oscillating Water Column are described. The Wave Chamber is an attenuator, designed to be moored submerged on tension leg moorings in deep water. The Twin Oscillating Water Column, which does not require wave spanning capability for its operation is envisaged as an inshore submerged device, piled into the sea bed. Results from experiments in the Edinburgh Tank Facility have been extrapolated to suggest that both the Wave Chamber and the Twin Oscillating Water Column could produce electricity from a 2 GW station for approximately 6p/kW hr, but it is difficult to put confidence limits on this figure until full scale design studies have been made.

42992 **(ETSU-WV—1652-Pt.2) Wave power system simulation. Second and final project report.** Jefferys, E.R.; Knott, G.F. (UKAEA Harwell Lab. Energy Technology Div.). Nov 1981. 92p. Patent Office, 25 Southampton Buildings, London, WC2A 1AY.

The development of techniques and computer programs for investigating interactions in and among wave energy devices, taking account of directional sea effects is described. Time-domain techniques for simulating the fluid dynamics have been developed and applied to the modelling of isolated and multiple devices. Three computer programs have been written to simulate: (1) an isolated single degree of freedom oscillating water column device with various types of power take off including rectification and latching; (2) an array of single degree of freedom OWC's subject to directional waves with power absorbed by separate air turbines or by a common main feeding a single turbine; (3) an array of devices subject to directional waves and interacting hydrodynamically with each other.

42993 **(ETSU-WV—1675-Pt.1) Small scale shoreline gully wave energy device. Phase 1.** Whittaker, T.J.T.; Long, A.E.; McPeake, F.; Barr, A.G. (UKAEA Harwell Lab. Energy Technology Div.). Oct 1987. 122p. British Library Document Supply Centre, Boston Spa, Wetherby, West Yorks. LS23 7BQ.

A report is given on a detailed engineering design of a shoreline gully wave energy device for siting on the Island of Islay, Scotland. It consists of an oscillating water column device with 180 KW byplane Wells turbine generator. Tests have been carried out on a 1/50th scale model in a wave tank. It is expected that such devices can produced electricity for between 3 and 4p/kWh for a lifetime of 25 years.

42994 **(FWPP-RD—721/TN1-Vol.1) Study of sub-sea modules and submarine cable laying and protection. Vol.1: report.** Pass, H.; Newey, B.J. (Foster Wheeler Power Products Ltd., London (UK); UKAEA Harwell Lab. Energy Technology Div.). Feb 1981. 292p. (ETSU-WV—1624-Pt.1). British Library Document Supply Centre, Boston Spa, Wetherby, West Yorks LS23 7BQ.

A scheme envisaging diode bridge rectifier systems installed on a total of eight offshore platforms which receive their inputs from wave energy devices via individual submarine cables is discussed. Electrical systems, cable laying and protection, subsea modules, survey requirements and cost considerations are reviewed.

42995 **(FWPP-RD—721/TN1-Vol.2) Study of sub-sea modules and submarine cable laying and protection. Vol. 2: appendices.** Pass, H.; Newey, B.J. (Foster Wheeler Power Products Ltd., London (UK); UKAEA Harwell Lab. Energy Technology Div.). Feb 1981. 271p. (ETSU-WV—1624-Pt.2). British Library Document Supply Centre, Boston Spa, Wetherby, West Yorks LS23 7BQ.

The feasibility, the likely cost and timescale for the construction of tunnels under the sea off the Hebrides for the purpose of accommodating cables or other method of power transmission from wave energy devices back to the shore is examined. A general review of the geological conditions likely to be encountered offshore and their likely effect on tunnel construction is given and the methods of construction which would be applicable to tunnels driven in these conditions are assessed. The likely timescale for the construction of a project of this nature together with a broad brush estimate of cost are estimated.

17 WIND ENERGY

42996 (ETSU-N—109, pp 151-159) **Public funding for wind energy RD and D.** Ashton, M.D. (Department of Energy, London (UK)). 1988. NTIS (US Sales Only), PC A08. Order Number DE88753394/JAW. (CONF-8711186—).

From Use of composite materials for wind turbines workshop; Harwell, UK (4 Nov 1987).

The paper identifies the sources of funding for wind energy RD and D available from the United Kingdom Government departments and the CEC. It briefly outlines the criteria which must be met to quality for funding and how to apply for it.

42997 **(GB—131) Harnessing the wind: wind energy technology in Britain.** (Department of Energy, London (UK)). Nov 1987. 14p. NTIS (US Sales Only), PC A03. Order Number DE88753395/JAW.

The UK Department of Energy's wind energy programme aims to determine the technical feasibility of large wind turbines for electricity generation in Britain, to assess their environmental impact and public acceptability and to encourage work aimed at cost reductions and improved performance. Wind energy technology in Britain is now moving into the development and demonstration stage financed by both the public and the private sector. The Department is currently supporting a 60 metre diameter, 3MW rated, horizontal axis turbine in Orkney, a 55 metre, 1MW, horizontal axis, three bladed turbine in Kent and a vertical axis prototype variable geometry, 25 metre, 160 KW, machine at Camarthen Bay. Advanced design studies have also been commissioned and a programme of underlying research projects is being financed.

1701 Availability (climatology)

42998 (RISO-M—2510, pp 113-128) **Methodology for wind energy resource assessments.** Petersen, E.L. (Department for Meteorology and Wind Energy, Risoe National Laboratory DK). May 1987. NTIS (US Sales Only), PC A12/MF A01. Order Number DE88752922/JAW. (CONF-8705276—).

From Workshop of the European cooperative networks on rural energy on wind energy applications for rural areas; Roskilde, Denmark (14 May 1987).

CNRE Bulletin, 13.

The main objectives and the basic tasks for a wind energy resource assessment study is outlined. The current EEC project "Wind Atlas for the European Community" is used as a example for such a study. Since 1981 the nine countries in the EEC have collaborated towards the production of the atlas. For this purpose a division into non-complex and complex regions was made with respect to largescale features. A new model concept was developed for the non-complex terrain. The model can briefly be described as a double vertical extrapolation of wind speed in the atmospheric boundary layer. It starts with hourly surface observations, extrapolates these diabatically to the top of the boundary layer, then interpolates or extrapolates the "effective geostrophic wind" in the horizontal over distances of the order 50-100 km, and finally extrapolates downward again at a specified site to a specified height in the surface layer over a specified roughness. For the terrain classified as complicated the work is centered around numerical modelling of the flow and the evaluation of results from numerical simulations. In this note we concentrate mainly on the basic principles behind a resource assessment study as these have been developed during the work with the EEC windatlas.

42999 (RISO-M—2510, pp 129-138) **Wind energy exploitation in Czechoslovak agriculture.** Rychetnik, V. (CVUT-FS, Katedra Letadel, Praha CS). May 1987. NTIS (US Sales Only), PC A12/MF A01. Order Number DE88752922/JAW. (CONF-8705276—).

From Workshop of the European cooperative networks on rural energy on wind energy applications for rural areas; Roskilde, Denmark (14 May 1987).

CNRE Bulletin, 13.

1703 Regulations

43000 (RISO-M—2510, pp 63-74) **Licensing of windmills.** Jensen, P.H. (Test Station for Windmills, Department for Meteorology and Wind Energy, Risoe National Laboratory DK). May 1987. NTIS (US Sales Only), PC A12/MF A01. Order Number DE88752922/JAW. (CONF-8705276—).

From Workshop of the European cooperative networks on rural energy on wind energy applications for rural areas; Roskilde, Denmark (14 May 1987).

CNRE Bulletin, 13.

The licensing procedure coupled to a policy of subsidy has played a significant role in the development of windmills in Denmark. This licensing procedure has emerged from a liberally administered set of a modest number of general rules to a stage where more detailed requirements are more rigorously administered, and the development of actual design specifications is today one of the main aspects of the work on the Test Station.

1704 Economics

REFER ALSO TO CITATION(S) 43304, 43306

1706 Wind Energy Engineering

REFER ALSO TO CITATION(S) 43305, 43531

43001 (CPP—011975) **The development of a prototype facility for a large diameter vertical axis wind turbine.** (Champlain Power Products Ltd., Toronto, Ontario (Canada)). Jan 1975. 21p. (CE—01619). CANMET/TID, Energy, Mines and Resources Canada, 555 Booth St., Ottawa, Ont., Canada K1A 0G1; $0.34CAN per page, $3.40 CAN minimum.

A proposal is made in this document for the design, construction, assembly and test of a demonstration wind turbine generator system. The specific objective of the program will be to demonstrate that the proposed system satisfies the need for cheap power generation at those remote meteorological stations which currently rely exclusively on fossil fuel that must be transported to the site at great cost. It intends to demonstrate that a large vertical axis wind turbine system is within the current state-of-art, is practical and is economically attractive. The program will include a conceptual design phase, a detail design phase, a construction and assembly phase at a selected site and a demonstration phase during which data will be gathered on operation at this large scale. A theory of operation of the proposed design is included. 4 refs., 3 figs.

43002 (DAF—187) **Development, construction and testing of a vertical axis 200 kW wind turbine.** (Dominion Aluminum Fabricating Ltd., Cooksville, Ontario (Canada)). 20 Dec 1974. 78p. (CE—01612). CANMET/TID, Energy, Mines and Resources Canada, 555 Booth St., Ottawa, Ont., Canada K1A 0G1; $0.34CAN per page, $3.40 CAN minimum.

It is proposed to design and develop a large vertical axis wind turbine that will generate economically 200 kilowatts of power at a wind speed of about 30 miles per hour. The scope of this proposal is to carry out studies, build, erect and test an electrical power generation plant that will feed into existing power grids. Preliminary technical studies indicate that the power of the turbine increases with the third power of the the wind speed. The rotor power loading should be as high as the prevailing winds allow; thus it would always be advisable to let the rotor run at as high an rpm as the economics will allow. For turbines up to about 100 ft in diameter, an extruded blade seems to be the best solution for economic rotor design. A 300 ft/s runaway tip speed seems to be acceptable as an rpm limit. Structurally, it is advantageous to increase the blade airfoil section to 18%. The proposed program has a very high probability of success in that each element of the total system involves a very low technical risk. The manufacturing methods rely on existing technology, and preliminary research indicates that readily available commercial materials can be used. There will be no involvement with highly stressed, fatigue-sensitive components. The total unit energy cost will be about fifty percent less for the proposed 90 ft. turbine than for the 15 ft. turbine produced for the National Research Council. 8 figs., 12 tabs.

43003 (DG—041982) **Comparison study of wind turbines.** (Dalcor Group, Edmonton, Alberta (Canada)). Apr 1982. 42p. (CE—01595). CANMET/TID, Energy, Mines and Resources Canada, 555 Booth St., Ottawa, Ont., Canada K1A 0G1; $0.34CAN per page, $3.40 CAN minimum.

A study was conducted to investigate the performance of a proposed delta-blade wind turbine compared to other existing wind-powered generators. The application for each of the machines was to provide energy supply to an irrigation water pumping scenario in Alberta. Wind generation scenarios were constructed for each of the manufacturers' standard units based on first principles of wind energy conversion. The performance analysis and subsequent economic evaluation depend significantly on the graphical interpretation of wind generator load factors derived in a prior study

performed for the Government of British Columbia. The technical analysis focused primarily on a delta-blade machine, whose the key advantage is simplicity. Current aerogenerator systems tend to rely on complex electronic controllers and measuring devices. The delta-blade reacts mechanically to changing conditions and as the system employs low rotational rotor speed, there should be less opportunity for component failure. Some conclusions are: provided it achieves the expected high energy conversion efficiency, the delta-blade and variable capacity pump system concept is an economical alternative, electric grid supply is more economical at this time than wind conversion systems assuming a common economic comparison, the energy conversion and transfer concepts for the delta-blade system appear technically sound, although the stroke control box and internal mechanisms require careful development and testing, and application of the delta-blade system to a year-round duty cycle would be highly cost advantageous for continued development of the concept. 11 refs., 8 tabs.

43004 **(EFI-TR—3467) IEA wind/diesel model validation exercise.** Uhlen, K.; Skarstein, Oe. (Elektrisitetsforsyningens Forskningsinstitutt, Trondheim (Norway)). Dec 1987. 30p. NTIS (US Sales Only), PC A03/MF A01. Order Number DE88752097/JAW.

This report describes the results of an IEA trial validation of mathematical models of autonomous wind/diesel power plant performance. Two models developed at The Norwegian Research Institute of Electricity Supply (EFI) are validated against measured data from a wind/diesel test plant at ECN in Netherlands. The first model (VINDI) gives a detailed description of the dynamic behavior (time step approx. 20 ms), and the second model describes long term performance (time step approx. 10 min). The model results agree, within experimental uncertainty, with the ECN measurements. 20 figs.

43005 **(ETSU-N—109) Use of composite materials for wind turbines.** (British Wind Energy Association, London; Department of Energy, London (UK)). 1988. 154p. (CONF-8711186—). NTIS (US Sales Only), PC A08. Order Number DE88753394/JAW.

From Use of composite materials for wind turbines workshop; Harwell, UK (4 Nov 1987).

The meeting discussed the substantial advances which have been made in the use of composites in industry, sought to relate them to the requirements of the wind turbine industry and identify areas in which further R and D effort is required.

43006 (ETSU-N—109, pp 13-43) **Current use of GRP as the main structural material for large (MW) blades.** Phillips, D.C. (UKAEA Harwell Lab. Materials Development Div.). 1988. NTIS (US Sales Only), PC A08. Order Number DE88753394/JAW. (CONF-8711186—).

From Use of composite materials for wind turbines workshop; Harwell, UK (4 Nov 1987).

Glass reinforced plastics have been used extensively in the construction of blades for large wind turbines: in some machines providing relatively lightly stressed aerofoil profiles over a main, load bearing, steel spar, or as cladding material for wood; in other designs acting as the main load bearing material. A very brief overview will be given of the different types of large blades which have been manufactured for MW scale machines. The blades for which GRP has been employed as the main load bearing material, and their methods of fabrication, will be described in more detail and comments made on operating experience. The design philosophy for high performance composite structures will be outlined, and comments made on the relevance of the experience of other industrial sectors.

43007 (ETSU-N—109, pp 53-67) **Design requirements for medium and large H.A.W.T.G.S. .** Turner, J.E.; Henderson, G. (British Wind Energy Association, London). 1988. NTIS (US Sales Only), PC A08. Order Number DE88753394/JAW. (CONF-8711186—).

From Use of composite materials for wind turbines workshop; Harwell, UK (4 Nov 1987).

Design requirements for wind turbine blades of intermediate size include strength, stiffness, weight, geometry, lightning protection and surface finish. These are currently met in the case of WEG MS2 blades by using wood-epoxy as the structural material. Future developments using advanced composites depend on producing a design which can be shown to compare favourably with the wood composite blade in terms of reliability, cost and performance.

43008 (ETSU-N—109, pp 69) **Composites in the design of VAWTG motors.** Mays, I.D. 1988. NTIS (US Sales Only), PC A08. Order Number DE88753394/JAW. (CONF-8711186—).

From Use of composite materials for wind turbines workshop; Harwell, UK (4 Nov 1987).

The loading regime for a vertical axis wind turbine blade is outlined. Options for the blade material, both metallic and non-metallic, with predicted weights and costs, are reviewed. The design of an advanced composite blade is discussed with reference to critical load cases and failure criteria and fabrication techniques are looked at. Areas identified as requiring further development are bonded/bolted joints, fatigue data and weathering over a prolonged period.

43009 (ETSU-N—109, pp 71-101) **Passive aerodynamic control using composite blades.** Karaolis, N.M.; Musgrove, P.J.; Jeronimidis, G. (Reading Univ. (UK)). 1988. NTIS (US Sales Only), PC A08. Order Number DE88753394/JAW. (CONF-8711186—).

From Use of composite materials for wind turbines workshop; Harwell, UK (4 Nov 1987).

The coupling characteristics of laminated composite materials allow the aerodynamic and centrifugal loads acting on wind turbine blades to be used to twist the blades and effect power control passively in either horizontal or vertical axis machines. For a thin-walled composite tube, bending/twisting coupling is obtained when the fibre orientation of the layers on the side above the tube's chord plane is the mirror image of the one below. On the other hand, stretching/twisting coupling results in the case where the fibres of a particular lamina are wound helically and the fibre orientation is constant around the tube's outer surface. Calculations have been performed to optimise the laminae fibre angles for maximum coupling on both types of lay-up. Bending and torsional stiffnesses have also been calculated. Optimum predicted orientations have been used to calculate stresses, strains, twisting curvatures and bending curvatures in different blade geometries and their effects on the wind turbine performance have been evaluated.

43010 (ETSU-N—109, pp 103) **Application of advanced composites to wind turbine rotors.** Davies, T.O. (Howden (James) and Co. Ltd., Glasgow (UK)). 1988. NTIS (US Sales Only), PC A08. Order Number DE88753394/JAW. (CONF-8711186—).

From Use of composite materials for wind turbines workshop; Harwell, UK (4 Nov 1987).

The paper comprises a comparison of the approximate weight and material costs of current FRP composite rotor blades with those of wood epoxide construction. Significant areas of blade design are highlighted and a brief look at possible trends in rotor design is included. Several questions are raised: for example can the use of advanced FRP composite engineering match the use of wood epoxide for current rotors and can any materials answer the challenge of future rotor development options? The paper concludes with discussion of the thesis that if advanced composite engineering is required for future rotors, experience must be gained from the current generation of machines.

43011 (ETSU-N—109, pp 105-115) **Lightweight rotors - at what cost? The first step towards economic wind turbines?.** Milborrow, D.J. (Central Electricity Generating Board, London (UK)). 1988. NTIS (US Sales Only), PC A08. Order Number DE88753394/JAW. (CONF-8711186—).

From Use of composite materials for wind turbines workshop; Harwell, UK (4 Nov 1987).

A previous study (Milborrow, 1986) indicated that the design of wooden wind turbine blades would probably be strongly influenced by the 'extreme gust' criterion but blade design with other materials would be influenced more by turbulent loads, where weight/(strength)2/3 rather than the weight to strength ratio is the

important factor. It is possible to quantify how rotor weights may be reduced by the use of advanced composites and indicate, in broad terms, the relative cost. Examples of actual rotor weights are used to support an analytical approach and illustrate the weight savings achievable with composites. Finally, an assessment of the consequential weight savings in the transmission, nacelle and support tower is made.

43012 (ETSU-N—109, pp 117-140) **Future for wood composite blades.** Platts, M.J. 1988. NTIS (US Sales Only), PC A08. Order Number DE88753394/JAW. (CONF-8711186—).

From Use of composite materials for wind turbines workshop; Harwell, UK (4 Nov 1987).

The progress in wind turbine blade construction from wood/epoxy to the present wood/composite balance is examined. Comparisons are made with other forms of construction, with particular reference to UK technology as it relates to large rotors. The examination is extended from blades to totally wood/composite rotors and the possibility of replacing metal components by composites.

43013 (ETSU-N—109, pp 149) **Testing of wind turbine blades.** Wells, J.R. (National Engineering Lab., East Kilbride (UK)). 1988. NTIS (US Sales Only), PC A08. Order Number DE88753394/JAW. (CONF-8711186—).

From Use of composite materials for wind turbines workshop; Harwell, UK (4 Nov 1987).

Proof loading of a large wind turbine blade which has to withstand gust wind forces of 69msec involves high reaction forces. NEL's strongfloor provides a ready made facility for this sort of testing. A test rig was designed to accept blades up to 26.5m long with a distributed load of up to 40 tons. Tip deflections under load of up to 3.5m had to be accommodated with a root Bending Moment of about 350 ton M. Consideration had to be given to failure of the blade under the test loading and how to arrest the falling load of 40 tons. The test rig design and operation will be described briefly. The test rig is now being modified so that a fatigue test at a specified hub bending moment and shear force can be carried out for up to 10^6 cycles. The actual test parameters have yet to be decided but loadings up to the equivalent of the maximum operating wind speed can easily be accommodated.

43014 (ETSU-N—109, pp 161-185) **Discussion.** 1988. NTIS (US Sales Only), PC A08. Order Number DE88753394/JAW. (CONF-8711186—).

From Use of composite materials for wind turbines workshop; Harwell, UK (4 Nov 1987).

The initial discussion reflected considerable enthusiasm for the wood epoxy composite as a blade material for the current generation of wind turbines. The need was expressed for more fundamental understanding of fatigue in wood and for extending investigations into a number of different woods in order to avoid supply problems arising from dependence on just one or two. It was argued, however, that the properties of wood must be considered as part of the total composite. Subsequent discussion moved to a broader spectrum of composites. The view was expressed that not enough is known about composite design and the development of fibre reinforced plastics. The cost of exploring the wide range of fibre/resin systems available was pointed out. Support was expressed for the view that the choice of blade material should emerge from a consideration of the overall design of the turbine. Other topics discussed included fail safe mechanisms, the cost effectiveness of teetered rotors, the availability of reliable fatigue data and passive aerodynamic control.

43015 (ETSU-WN—5005/4) **Wind measurements on Burgar Hill, Orkney. Phase 2 study.** Haines, R.S. (ed.). (UKAEA Harwell Lab. Energy Technology Div.). Nov 1987. 339p. (WEG-A—80-4004). British Library Document Supply Centre, Boston Spa, Wetherby, West Yorks. LS23 7BQ.

A detailed full-scale investigation has been carried out of the structure of mean winds and turbulence over Burgar Hill, Mainland Orkney. The principal data was recorded from anemometers mounted on an 80m mast over the periods January-May 1985, August-October 1986 and March-May 1987. Cup anemometers were used for the first period, and sonic anemometers for the subsequent periods. The long term mean wind speed is estimated to be 11.1m/s at hub height of the Wind Energy Group's 60m diameter Wind Turbine Generator on Burgar Hill, and 10.4m/s at hub height of the WEG 20m WTG. The data presented includes mean wind speed distributions, shear profiles, turbulence intensity, gust factors, power spectral density plots, windspeed variations between the two masts, Reynolds shear coefficients, variation of wind direction with height, peak factors, turbulence length scales, and wind elevation angles. The conclusion is drawn that the low frequency part of the von Karman spectrum does not usefully represent the wind characteristics at this site. Alternative methods of characterising turbulence structure are suggested.

43016 (ETSU-WN—5054/1) **Wind tunnel tests on thickened and truncated aerofoils for wind turbines.** Reddy, M.T. (UKAEA Harwell Lab. Energy Technology Div.). Dec 1987. 58p. British Library Document Supply Centre, Boston Spa, Wetherby, West Yorks. LS23 7BQ.

The results of a series of wind tunnel tests conducted in the 11'x8' wind tunnel at Southampton University are presented. An investigation was made into the effects of truncation, of up to 40% full chord, on the two-dimensional aerodynamic characteristics of thick aerofoil sections, typical of those used in the root region of horizontal wind axes turbine blades. Lift, drag and moment coefficients were calculated from balance measurements and are presented for six aerofoil sections, varying in thickness from 21% to 40% of the chord length, at Reynolds Numbers between 0.3x10/sup 6/ and 2.0x10/sup 6/. Truncated and untruncated section characteristics are compared and trends discussed. Variation of pressure distributions with truncation are also included. Results indicated that section characteristics vary considerably with truncation. Drag generally increased with truncation, particularly for the thicker sections.

43017 (RISO-M—2510, pp 49-62) **Testing of grid-connected windmills.** Pedersen, T.F. (Test Station for Windmills, Department for Meteorology and Wind Energy, Risoe National Laboratory DK). May 1987. NTIS (US Sales Only), PC A12/MF A01. Order Number DE88752922/JAW. (CONF-8705276—).

From Workshop of the European cooperative networks on rural energy on wind energy applications for rural areas; Roskilde, Denmark (14 May 1987).

CNRE Bulletin, 13.

The testing of windmills at the Test Station for Small Windmills at Risoe has been developed to a standard test procedure, which is described in this paper. The test facilities are briefly mentioned and the instrumentation is outlined in detail. The measurements are described, beginning with function testing through structural measurements to performance testing.

43018 (RISO-M—2510, pp 75-77) **Windpumps, water heating and battery charging windmills.** Krogsgaard, J.; Johnsen, J. (Test Station for Windmills Department for Meterology and Wind Energy, Risoe National Laboratory DK). May 1987. NTIS (US Sales Only), PC A12/MF A01. Order Number DE88752922/JAW. (CONF-8705276—).

From Workshop of the European cooperative networks on rural energy on wind energy applications for rural areas; Roskilde, Denmark (14 May 1987).

CNRE Bulletin, 13.

43019 (RISO-M—2510, pp 79-90) **Wind/diesel systems research.** Aagaard Madsen, H. (Test Station for Windmills Department for Meterology and Wind Energy, Risoe National Laboratory DK). May 1987. NTIS (US Sales Only), PC A12/MF A01. Order Number DE88752922/JAW. (CONF-8705276—).

From Workshop of the European cooperative networks on rural energy on wind energy applications for rural areas; Roskilde, Denmark (14 May 1987).

CNRE Bulletin, 13.

The different activities of the Risoe w/d programme that have been carried out or are presently in operation or planned can be summarized as follows: a. Development of two w/d systems. a1:

30-kW state-of-the-art system without enrgy storage. a2: 25-kW advanced system with energy storage. b. Test facility and the testing of w/d systems. b1: Establishment of a universal test facility for w/d systems. b2: Testing the two w/d systems mentioned above under a1 and a2. b3: Development of a standard procedure for testing w/d systems. c. Measurements on a small grid. d. Research and development. d1: Diesel start/stop (start with flywheel). d2: System dynamics (short-time simulation). d3: Control Strategies. d4: System economics (long-time simulation). e. Consultancy to industry. (EG).

43020 (RISO-M—2510, pp 91-104) **Preoccupations and perspectives concerning wind energy, construction and testing of the TEV-100 darrieus wind turbine.** Vlad, I. (ICSITMUA-Sector Brasov, Brasov RO). May 1987. NTIS (US Sales Only), PC A12/MF A01. Order Number DE88752922/JAW. (CONF-8705276—).

From Workshop of the European cooperative networks on rural energy on wind energy applications for rural areas; Roskilde, Denmark (14 May 1987).

CNRE Bulletin, 13.

43021 (RISO-M—2510, pp 105-111) **Possibilities and needs for development of wind energy technologies in Yugoslavia.** Popovic, M.M. (University of Belgrade, Institute of Physics, Zemun YU). May 1987. NTIS (US Sales Only), PC A12/MF A01. Order Number DE88752922/JAW. (CONF-8705276—).

From Workshop of the European cooperative networks on rural energy on wind energy applications for rural areas; Roskilde, Denmark (14 May 1987).

CNRE Bulletin, 13.

43022 (RISO-M—2510, pp 139-144) **Possibilities of utilizing the wind energy in the agricultural production of the p.r. of Bulgaria.** Bourov, I. (Union Nationale Agro-Industrielle, Sofia GB). May 1987. NTIS (US Sales Only), PC A12/MF A01. Order Number DE88752922/JAW. (CONF-8705276—).

From Workshop of the European cooperative networks on rural energy on wind energy applications for rural areas; Roskilde, Denmark (14 May 1987).

CNRE Bulletin, 13.

43023 (RISO-M—2510, pp 145-149) **Energy storage for wind energy applications in rural areas.** Mayer, R.M. (BP Research Centre, Middlesex GB). May 1987. NTIS (US Sales Only), PC A12/MF A01. Order Number DE88752922/JAW. (CONF-8705276—).

From Workshop of the European cooperative networks on rural energy on wind energy applications for rural areas; Roskilde, Denmark (14 May 1987).

CNRE Bulletin, 13.

43024 (RISO-M—2510, pp 151-156) **Experience in the use of wind energy for greenhouse heating.** O'Flaherty, T. (Agricultural Institute, Kinsealy Research Centre, Dublin IR). May 1987. NTIS (US Sales Only), PC A12/MF A01. Order Number DE88752922/JAW. (CONF-8705276—).

From Workshop of the European cooperative networks on rural energy on wind energy applications for rural areas; Roskilde, Denmark (14 May 1987).

CNRE Bulletin, 13.

Study of the appliction of wind energy for greenhouse heating began at Kinsealy Research Centre in 1980 with the installation of a multi-blade 6m diamter wind turbine. This produced electricity which was used to provide root zone warming for a glasshouse tomato crop. The application worked well and the wind turbine is still in operation, although it has been out of service for substantial periods and has required major refurbishment. In July 1985 a new wind turbine was commissioned as an EEC Wind Energy Demonstration Project. This is an 11m diameter grid-connected unit, and the project involves using its output to power a heat pump which in turn supplies heat to a greenhouse. The system is operating well and initial performance results have been obtained during the 1985-'86 heating season. The paper summarises the experience to data with both of these projects.

43025 (RISO-M—2510, pp 157-166) **Use of wind generators in agriculture to pump water and to aerate sewage reservoirs.** Toth, L.; Honti, V.; Bak, J. (National Institute of Agricultural Engineering, Goedoelloe HU). May 1987. NTIS (US Sales Only), PC A12/MF A01. Order Number DE88752922/JAW. (CONF-8705276—).

From Workshop of the European cooperative networks on rural energy on wind energy applications for rural areas; Roskilde, Denmark (14 May 1987).

CNRE Bulletin, 13.

43026 (RISO-M—2510, pp 167-173) **Wind energy for agricultural applications.** Werkhoven, C. (Institute of Agricultural Engineering IMAG, Wageningen NL). May 1987. NTIS (US Sales Only), PC A12/MF A01. Order Number DE88752922/JAW. (CONF-8705276—).

From Workshop of the European cooperative networks on rural energy on wind energy applications for rural areas; Roskilde, Denmark (14 May 1987).

CNRE Bulletin, 13.

43027 (RISO-M—2510, pp 175-180) **Wind energy applications for water pumping.** Gaudiosi, G.G.; Pirazzi, L. (ENEA-CRE, CASSACIA-FARE, Rome IT). May 1987. NTIS (US Sales Only), PC A12/MF A01. Order Number DE88752922/JAW. (CONF-8705276—).

From Workshop of the European cooperative networks on rural energy on wind energy applications for rural areas; Roskilde, Denmark (14 May 1987).

CNRE Bulletin, 13.

43028 (RISO-M—2510, pp 181-198) **Design of piston pumps for windmills.** Boldt, J.; Henriksen, U.; Voelund, P.; Hundeboel, I. (The Rural Energy Group, Laboratory for Energetics, Technical University of Denmark, Lyngby DK). May 1987. NTIS (US Sales Only), PC A12/MF A01. Order Number DE88752922/JAW. (CONF-8705276—).

From Workshop of the European cooperative networks on rural energy on wind energy applications for rural areas; Roskilde, Denmark (14 May 1987).

CNRE Bulletin, 13.

Water-lifting windmills are available in numerous different designs. Despite the varoius purposes, the great majority is based on one and only basic principle, the so-called wind pump. In this paper a wind pump is defined as a purely mechanical (no electricity, no hydraulics) combination of a wind turbine and a reciprocating piston pump. The paper is concerned with some of the most essential design restrictions one has to consider when involved in wind pumps. The primary emphasis is on the pump. Wind pumps are of special interest in less developed countries, where thousands of villages lack electricity and regular access to petroleum products. Designing technology for such uses implies the involvement of various non-technical disciplines. However, this is a story in itself, so to keep the extent of the discussion at a reasonable level, the present paper merely deals with technical aspects of wind pumps

43029 (RISO-M—2510, pp 199-206) **Wind powered ice plant.** Baastrup Jacobsen, E. (Manager, Product Engineering Department in Copenhagen, Thomas Ths. Sabroe A/S, Hoejbjerg DK). May 1987. NTIS (US Sales Only), PC A12/MF A01. Order Number DE88752922/JAW. (CONF-8705276—).

From Workshop of the European cooperative networks on rural energy on wind energy applications for rural areas; Roskilde, Denmark (14 May 1987).

CNRE Bulletin, 13.

43030 (RISO-M—2510, pp 207-210) **New Danish windpump.** Jensen, J.B. (The Danish Centre for Renewable Energy, Sdr. Ydby, Hurup DK). May 1987. NTIS (US Sales Only), PC A12/MF A01. Order Number DE88752922/JAW. (CONF-8705276—).

From Workshop of the European cooperative networks on rural energy on wind energy applications for rural areas; Roskilde, Denmark (14 May 1987).

CNRE Bulletin, 13.

43031 (RISO-M—2510, pp 211-217) **Construction and exploitation criteria of wind power plants in Poland.** Kukla, T. (IMBER, Institute for Building, Mech. and El. in Agriculture, Warsaw PL). May 1987. NTIS (US Sales Only), PC A12/MF A01. Order Number DE88752922/JAW. (CONF-8705276—).

From Workshop of the European cooperative networks on rural energy on wind energy applications for rural areas; Roskilde, Denmark (14 May 1987).

CNRE Bulletin, 13.

We find wind power plant construction quite material-consuming. The good efficiency of wind power plants depends on its situation in a good wind conditions of average wind speed of above 4 m/s. The general criterium of material-consumption and situation can be the fact of obtaining within the period of one year at least 3 KWh or 10 MJ of heat energy out of 1 kg wind power plant construction and its devices.

43032 (RISO-M—2510, pp 219-228) **Description of the wind energy activities of the consulting engineers Holland Windturbine B.V. .** Foellings, F. (Holland Windturbine B.V., Utrecht NL). May 1987. NTIS (US Sales Only), PC A12/MF A01. Order Number DE88752922/JAW. (CONF-8705276—).

From Workshop of the European cooperative networks on rural energy on wind energy applications for rural areas; Roskilde, Denmark (14 May 1987).

CNRE Bulletin, 13.

43033 (RISO-M—2510, pp 235-240) **UNSO/UNDP wind energy projects in the Republic Cape Verde.** Lundsager, P. (Wind Engineering Section, Risoe National Laboratory DK). May 1987. NTIS (US Sales Only), PC A12/MF A01. Order Number DE88752922/JAW. (CONF-8705276—).

From Workshop of the European cooperative networks on rural energy on wind energy applications for rural areas; Roskilde, Denmark (14 May 1987).

CNRE Bulletin, 13.

The paper describes two UNSO/UNDP projects in the Cape Verde Islands, that includes the implementation of a Wind/Diesel system with battery storage. The paper describes the project and the future potential for wind energy in Cape Varde is disussed.

43034 (RISO-M—2510, pp 241-250) **Simulation model of collective combined energy systems.** Fenhann. J. (Energy Systems Group, System Analysis Department, Risoe National Laboratory DK). May 1987. NTIS (US Sales Only), PC A12/MF A01. Order Number DE88752922/JAW. (CONF-8705276—).

From Workshop of the European cooperative networks on rural energy on wind energy applications for rural areas; Roskilde, Denmark (14 May 1987).

CNRE Bulletin, 13.

43035 **(RISO-M—2567) Results from the experimental wind/diesel system at Risoe January 19 - April 1987.** Aagaard Madsen, H.; Greisen. H. (Risoe National Lab., Roskilde (Denmark)). Jun 1987. 37p. NTIS (US Sales Only), PC A03/MF A01. Order Number DE88752080/JAW.

The report describes some of the experimental results made at the Wind/Diesel system at The Test Station for Windmills, Risoe. The measurements are from the three operating modes of the system, the wind turbine operating alone, the diesel generator set operating alo and the wind turbine and the diesel generator set working in paralle This is the first report containing experimental results at the Wind/Diesel system at Risoe and it will give a base for the further work at this system.

43036 **(SAND—87-1506) Modal testing the EOLE.** Carne, T.G.; Lauffer, J.P.; Gomez, A.J.; Benjannet, H. (Sandia National Labs., Albuquerque, NM (USA); Shawinigan Engineering Co. Ltd., Montreal, Quebec (Canada)). Apr 1988. Contract AC04-76DP00789. 20p. NTIS, PC A03/MF A01;1; GPO Dep. Order Number DE88010607/JAW.

This report presents the results of the modal test of the 110-m-tall EOLE wind turbine. Modal testing an immense and flexible wind turbine poses a number of problems. It requires innovative excitation techniques since the modal frequencies of this type of structure are quite low {emdash} some below 1.0 Hz. Also, substantial energy must be input to the structure to obtain reasonable levels of response. Step-relaxation and wind were used to excite the structure.

20 ELECTRIC POWER ENGINEERING

2001 Power Plants And Power Generation

REFER ALSO TO CITATION(S) 42554, 42624, 42643, 42670, 43044, 43111, 43129, 43132, 43134, 43135, 43146, 43147, 43152, 43153, 43154, 43155, 43156, 43159, 43160, 43161, 43264, 43265, 43266, 43310, 43439, 43745, 44060, 44493

43037 **(BWC-TR—85-14) Coal water fuel derating assessment for the front wall-fired oil design boiler No. 10, Maritime Electric Company, Charlottetown, PEI.** Vicardi, R.P. (Canada Centre for Mineral and Energy Technology, Ottawa, Ontario). 1985. 48p. CANMET, 555 Booth St, Ottawa, Canada K1A 0G1.

This study was undertaken to determine to what level the oil fired No. 10 boiler at Maritime Electric Company, Charlottetown, PEI would have to be derated for firing coal water slurry (CWS). Tests were performed with only one type of CWS -- CARBOGEL. Babcock & Wilcox's computer modelling technique was used to arrive at the derated levels. Changes to the boiler to decrease the severity of deration are suggested. Ash accumulation resulting from the use of CWS has been identified as a potential problem area. 8 refs., 5 tabs., 8 figs.

43038 (CONF-850982—, pp 13-22) **Cool water project clean power from coal.** Wolk, R.H.; Holt, N.A. (Electric Power Research Institute, Palo Alto, CA (USA)). 1985. NTIS, PC A99/MF A01. Order Number DE88007794/JAW.

From 2. annual Pittsburgh coal conference; Pittsburgh, PA, USA (16 Sep 1985).

The Cool Water project is a 100 MW (net electrical output) integrated coal gasification combined-cycle project that produces the cleanest power generated from coal that the world has ever seen. Design goals for gas turbine stack emissions are 9 ppm SO/sub x/ (0.033 lbs 10^6 Btu fuel), 27 ppm NO/sub x/ (0.065 lbs10^6 Btu fuel) and 0.01 lbs of particulates10^6 Btu fuel for operations on low sulfur Utah coal. All of these goals have been exceeded. Other products from the plant are bright yellow sulfur which is sold commercially and glassy nonleachable slag which is disposed of in an on-site clay lined pit. That slag has been found to be non-hazardous by the California Department of Health. In late 1985 and early 1986, a series of test runs is scheduled on high-sulfur Illinois and Pittsburgh coals. Sulfur emissions for those coals are designed to be 175 lbshr which corresponds to 97% sulfur removal. The plant is located at the Cool Water station of the Southern California Edison Company in Daggett, California. Initial commercial operation began in late June 1984 approximately six weeks after the completion of construction which required 28 months. The construction and start-up cost was $263 million, which was approximately 10% below budget.

43039 **(CONF-880702—14) Emission studies of full-scale cofiring of pelletized RDF/coal at Argonne National Laboratory.** Ohlsson, O.O.; Daugherty, K.; Venables, B. (Argonne National Lab., IL (USA)). May 1988. Contract W-31-109-ENG-38. 6p. NTIS, PC A 02; 3; GPO Dep. Order Number DE88012145/JAW.

From 23. intersociety energy conversion engineering conference; Denver, CO, USA (31 Jul 1988).

In FY 1984, Argonne National Laboratory (ANL) issued a competitively solicited research contract to North Texas State University (NTSU) to conduct a multi-phase research study to examine the use of low-cost binders for producing improved densified refuse-derived fuel (dRDF) pellets. The laboratory test phase of this study was completed in FY 1984 and the pilot plant phase in FY 1985. The results of these tests indicated that lime (calcium hydroxide) was the top-ranked binding agent. As the third and final phase of the multi-phase study, ANL/NTSU conducted full-scale cofired combustion tests of binder-enhanced dRDF pellets and high-sulfur coal. These tests were conducted during June and July of 1987 in ANL's Boiler No. 5, which is a spreader-stoker boiler. These tests were conducted with industry, state, and municipality participation both in critiquing the test plan and in witnessing the actual test runs. Approximately 600 tons of dRDF containing 0%, 4%, or 8% binder were blended with high-sulfur coal at levels of up to 30%, based on the Btu content. This paper describes the dRDF/coal cofiring test, the emission and ash samples that were taken, the analyses which were conducted on these samples, preliminary test results, and future research plans.

43040 (EPRI-NP—5490-SR, pp 3.1-3.2) **Steam line condition monitoring utilizing acoustic emission.** Sherlock, T.P. (Babcock & Wilcox Co., Barberton, OH (USA)). Jun 1988. Research Reports Center, Box 50490, Palo Alto, CA 94303. Order Number TI88012214/JAW.

In Nondestructive Evaluation Program: Progress in 1987.

The failure of longitudinally welded hot reheat lines has prompted the utility industry to conduct extensive inspection programs. The preferred method of inspection is contact ultrasonic testing (UT) from the OD surface, which necessitates removal of the insulation (usually asbestos). One of the major objectives of the project is to validate the use of acoustic emission (AE) for locating flaws in steam lines, thereby negating the need for complete insulation removal. The results of several AE tests conducted on operating steam lines are discussed.

43041 (EPRI-NP—5490-SR, pp 4.1-4.5) **Remote internal inspection of steam lines.** Hedden, O.F.; McMillan, J.D. (Combustion Engineering, Inc., Windsor, CT (USA)). Jun 1988. Research Reports Center, Box 50490, Palo Alto, CA 94303. Order Number TI88012214/JAW.

In Nondestructive Evaluation Program: Progress in 1987.

The catastrophic failures of reheat lines at the Mohave and Monroe generating stations have provided impetus to the utility industry's need for a cost-effective nondestructive examination process for welds in high-energy steam lines; more recently, NRC Bulletin 87-01 extended the areas of concern in nuclear plants to wall-thinning measurements in various high-energy system lines. These are essential elements in the remaining life assessment programs being implemented in virtually every utility fossil and nuclear-powered generating station. After an extensive evaluation of current practices, it was decided to pursue development of a pipe I.D crawler. The development of a prototype crawler is discussed.

43042 (EPRI-NP—5490-SR, pp 25.1-25.9) **Advanced nondestructive evaluation methods for fossil boiler component inspection.** Lamping, G.A. (Southwest Research Institute, San Antonio, TX (USA)). Jun 1988. Research Reports Center, Box 50490, Palo Alto, CA 94303. Order Number TI88012214/JAW.

In Nondestructive Evaluation Program: Progress in 1987.

Electric utilities are requiring higher plant availability and longer plant service life in operating their generation system facilities. Component remaining life assessments are becoming integral portions of plant maintenance and life extension programs. Remaining life assessments, however, are difficult and expensive because many technical and physical aspects are involved. Nondestructive evaluation (NDE) methods are the primary tools for assessing the current condition of a component, which is a requirement for estimating the remaining service life. State-of-the-art NDE methods are successful in detecting macrotype flaws, but life extension applications have pushed the currently available NDE technology to its limits. Long-term damage to a component's structural material may consist of changes in microstructure or materials properties. Progress is being made to develop NDE methods to detect the microstructural changes caused by long periods of operation at elevated temperature and stress or by aqueous corrosion reaction. The microstructural changes cause damage by reducing the load-bearing capability, embrittling the material, or reducing the resistance to creep propagation. Advanced NDE methods applying ultrasonic velocity (UT) measurements for creep and hydrogen damage and Barkhausen Noise Analysis (BNA) are being investigated for development into field-usable systems. These methods are described.

2002 Environmental Control Technology

REFER ALSO TO CITATION(S) 42611, 42612, 42615, 42616, 42617, 42618, 42621, 42624, 42890, 43039, 43919, 43920, 43921

43043 (EPA—450/3-87-010a) **Chromium emissions from comfort cooling towers: Background information for proposed standards: Draft EIS.** (Environmental Protection Agency, Research Triangle Park, NC (USA). Office of Air Quality Planning and Standards). Mar 1988. 170p. US Environmental Protection Agency, Research Triangle Park, North Carolina 27711. Order Number TI88900632/JAW.

Standards of performance for the control of hexavalent chromium emissions from comfort cooling towers are being proposed under authority of Section 6 of the Toxic Substances Control Act. These standards would apply to existing and new comfort cooling towers. This document contains background information and environmental and economic impact assessments of the regulatory alternatives considered in developing the proposed standards. 104 refs., 9 figs., 41 tabs.

43044 (EPRI-NP—5490-SR, pp 35.1-35.4) **Nondestructive tests for temper embrittlement.** Richman, R.H. (Daedalus Associates, Inc., Mountain View, CA (USA)). Jun 1988. Research Reports Center, Box 50490, Palo Alto, CA 94303. Order Number TI88012214/JAW.

In Nondestructive Evaluation Program: Progress in 1987.

Temper embrittlement is the progressive reduction in toughness of alloy steels, brought about by long-term exposure to temperatures in the 300-600°C range. It is caused by segregation to grain boundaries of certain impurities dissolved in steels and is manifested as a change in the low ductility fracture mode from transgranular cleavage to intergranular separation. The problem of temper embrittlement affects the electric power industry most directly in its influence on the fracture toughness (i.e., resistance to unstable crack propagation) of rotor and disk steels in steam turbines. Currently, advanced surface analysis methods, such as auger electron spectroscopy (AES), are available to characterize the grain boundary composition, and substantial progress has been made in correlating the intergranular fracture behavior of steels to the grain-boundary composition. A nondestructive technique for estimating the extent of grain boundary segregation has been developed and tested against AES measurements of segregation. The new method consists of a picric acid etch (PAE) of a metallographically prepared surface and measurement of the depth of etching along the grain boundaries by progressive polishing of the surface. The objectives of the current project are to confirm the PAE-replica method for predicting embrittlement of NiCrMoV rotor steels, to demonstrate the test in the field, and to prepare detailed procedures for implementing the test.

2003 Power Transmission And Distribution

REFER ALSO TO CITATION(S) 43470, 43633, 43634, 43635, 43636, 43637, 43638

43045 **Gaseous dielectrics V.** Christophorou, L.G. Elmsford, NY; Pergamon Books Inc. (1987). 750p. Pergamon Books Inc., Manager/Publishing Services, Maxwell House, Fairview Park, Elmsford, NY 10523.

This book discusses the progress and problems of current interest in gaseous dielectrics and their use, with special emphasis on insulation in high-voltage transmission lines and substations. Topics covered include: basic physics of gaseous dielectrics; basic mecha-

nisms; gas decomposition, reactions and toxicity; diagnostics and field probes; gases and mixtures for GIS transformers and circuit breakers; gaseous media for discharge chemistry and etching/corona; gas engineering for pulsed power and switching; gas breakdown under steep-fronted voltages; new developments in gas-insulated equipment and gas handling; gas/insulator interface/flashover; and quality control in testing gas-insulated equipment. Contains approximately 85 papers.

43046 Impact of adaptive protection on power system control. Phadke, A.G.; Thorp, J.S.; Horowitz, S.H. (Virginia Tech, Blacksburg, VA (US)). pp 283-290 of Proceedings of the ninth power systems computation conference. Stoneham, MA; Butterworth Publishers (1987). (CONF-870877—).

From 9. power system computation conference; Cascais, Portugal (30 Aug 1987).

Use of computer based protection seems to be well accepted by the Electric Utility Industry. The newer concept of an integrated computer system for protection, monitoring and control of substations is also gaining favor among power system engineers. Such a system permits many innovations in protection and control of power apparatus within the substation, as well as on a system-wide basis. One such new concept is that of Adaptive Protection. Through measurements obtained from computer based protection systems, many features of the protection and control system can adapt to changing state of a power system. In the present state of technology, these features (or settings) are based upon certain assumed system conditions and loading levels. As the actual system conditions change, these compromise settings are no longer optimum, and may in certain circumstances be wrong for the prevailing state of the system. The paper presents conceptual design of several adaptive protection and control functions. A more detailed account of four functions: adaptive detection and control of instability, load shedding and restoration, out-of-step relaying, and adaptive synchronization - check relaying is given. The role of high speed communication channels in providing the adaptive ability is also to be explored.

43047 A comparison of dynamic security indices based on direct method. Fischl, R.; Mercede, F.; Wu, F.F.; Chiang, H.D. (Dept. of Electrical and Computer Engineering, Drexel Univ., Philadelphia, PA (US)). pp 110-116 of Proceedings of the ninth power systems computation conference. Stoneham, MA; Butterworth Publishers (1987). (CONF-870877—).

From 9. power system computation conference; Cascais, Portugal (30 Aug 1987).

This paper presents a comparison of direct methods of transient stability assessment. The emphasis is on stability criteria based on Lyapunov's direct method. The comparison is made by studying the similarities and differences in the regions of attraction which the direct method define. The region of attraction is characterized in terms of a performance index (PI) and threshold value (TH). This paper reformulates several forms of the PI and methods to evaluate TH defined in the literature in a unified mathematical notation. Comparison tables are presented to identify differences in the PI parameters threshold, and dynamic models.

21 NUCLEAR POWER PLANTS

REFER ALSO TO CITATION(S) 44519, 44522

2101 Power Reactors, Non-breeding, Light-water Moderated, Boiling Water Cooled

REFER ALSO TO CITATION(S) 43163, 43181, 43192, 43193, 43194, 43220, 43242, 43246, 43471, 43849, 43859

43048 (EPRI-NP—5086-Rev.1) Utility guide to advanced ultrasonic systems for preservice and in-service inspections, revision 1: Topical report, March 1988. Neeley, V.I. (VinTek, Inc., Richland, WA (USA); Electric Power Research Inst., Palo Alto, CA (USA). Nuclear Power Div.). Mar 1988. 89p. Research Reports Center, Box 50490, Palo Alto, CA 94303. Order Number TI88920264/JAW.

This report is the second compilation of information on advanced ultrasonic (UT) inspection systems and contains evaluation guidelines, relative inspection costs and systems availability data effective through calendar year 1987. It is intended to answer the need of utility NDE managers for guidelines to evaluate the merits of using advanced (UT) inspection systems. A large number of advanced UT systems are now commercially available and boast a variety of capabilities. These systems are called {open+-quotes}advanced{close+-quotes} because they employ state-of-the-art electronics, computers, and signal processing and imaging software. This guide recognizes that it is not expected of the NDE manager to be intimately familiar with all the components comprising a particular system, but rather that he be aware of the beneficial applications of such a system and its limitation. The guide includes systems that have applications to the inspection of boiling water reactor (BWR) piping. Information is presented in tabular form to facilitate simple comparisons between systems and to simplify access to system hardware and software requirements. A tutorial section discusses general ultrasonic inspection theory and gives a perspective from which a manager can view advanced systems. The dollars and cents of using an advanced UT system versus the standard manual mode inspection is also discussed. The results of a survey of utilities, service and vendor organizations are presented, cast in a benefit-to-cost framework. An example of specifications that a system should meet is also given and is modeled along the lines of a purchase order specification.

43049 (EPRI-NP—5427-Final) Evaluation of fuel-cladding properties at high temperatures: Final Report, April 1988. Goldstein, L.; Reyes, O.; Strasser, A.A. (Stoller (S.M.) Corp., New York (USA)). Apr 1988. 30p. ;1. Order Number TI88920267/JAW.

Current performance capabilities of fuel cladding could possibly be extended under severe accident conditions by using materials other than the Zircaloys or with clad coatings. Such materials would enhance LWR safety as they would extend the time to failure, and reduce the amount of hydrogen production and the extent of fuel clad ballooning. This study serves as a preliminaty screening tool to determine which materials would provide the desired improvements in stream oxidation resistance and elevated temperature strength in the case of severe accident conditions. The screening results showed that molybdenum and some of its alloys, and some niobium alloys, all commercially produced, could be possible candidates. The oxidation resistance of these materials as well as the Zircaloys could be enhanced when used with commercially available surface coatings. These fall into the general categories of silicides and aluminides. For the Zircaloys in particular, research would be required to develop successful coating and bonding techniques.

43050 (EPRI-NP—5760) Automated ultrasonic pipe examination and data interpretation: Interim report. Sasahara, T.; Ammirato, F.V. (Jones (J.A.) Applied Research Co., Charlotte, NC (USA)). Apr 1988. 73p. Research Reports Center, Box 50490, Palo Alto, CA 94303. Order Number TI88008437/JAW.

Automated systems are now available for ultrasonic examination of BWR piping welds. This report describes automated system operation and how systems are applied to piping examination. Characteristic features of crack, counterbore, and root signals encountered in BWR piping examination are described that can be used to classify the signal source. Example decision trees are developed to assist operators to properly discriminate the various sources of conflicting signal sources. Possibilities for using expert system technology for automated decision-making are explored. 5 refs., 38 figs., 1 tab.

43051 (EPRI-NP—5828) Workshop on initiation of stress corrosion cracking under LWR conditions: Proceedings. Nelson, J.L.; Cubicciotti, D. (eds.); Licina, G.J. (Electric Power Research Inst., Palo Alto, CA (USA); Structural Integrity Associates, San Jose, CA (USA)). May 1988. 217p. (CONF-8611248—). Unlimited audience, publicly available. Research Reports Center, Box 50490, Palo Alto, CA 94303. Order Number TI88011773/JAW.

From Workshop on initiation of stress corrosion cracking under LWR conditions; Palo Alto, CA, USA (13 Nov 1986).

A workshop titled "Initiation of Stress Corrosion Cracking under LWR Conditions" was held in Palo Alto, California on November 13, 1986, hosted by the Electric Power Research Institute. Participants were experts on the topic from nuclear steam supply and component manufacturers, public and private research laboratories, and university environments. Presentations included discussions on the definition of crack initiation, the effects of environmental and electrochemical variables on cracking susceptibility, and detection methods for the determination of crack initiation events and measurement of critical environmental and stress parameters. Examination of the questions related to crack initiation and its relative importance to the overall question of cracking of LWR materials from these perspectives provided inputs to EPRI project managers on the future direction of research efforts designed to prevent and control cracking. Thirteen reports have been cataloged separately.

43052 (INIS-SU—10, pp 58-66) **Technique for numerical analysis of stability and self-oscillations in boiling water cooled reactors.** Glebov, V.V. 1987. (In Russian). NTIS (US Sales Only), PC A05/MF A01. Order Number DE88780094/JAW.

Voprosy Atomnoj Nauki i Tekhniki.; (No. 2).
In Physics and technology of nuclear reactors.

Methods for investigating the boiling water cooled reactor dynamics, which consist in finding the boundary of neutron-physical and thermohydraulic process stability region and calculating the oscillation amplitudes occuring when moving inside the instability region, are proposed. The methods are based on the computerized calculation of transients for the quasistaical change of the parameter, determining the steady-state regime, which is performed according to the reactor nonlinear mathematical model. A boiling water cooled reactor with low coolant underheating up to the saturation temperature at the inlet to the reactor core is considered as an example. Bifurcation diagrams are plotted for different values of the reactor physical and design parameters.

43053 (SAND—88-1612C) **Parametric contain calculations of the containment response of the Grand Gulf plant due to reactor pressure vessel failure at high pressure.** Murata, K.K.; Louie, D.L.Y. (Sandia National Labs., Albuquerque, NM (USA)). 1988. Contract AC04-76DP00789. 20p. (CONF-880616—3). NTIS, PC A03/MF A01; 1; GPO Dep. Order Number DE88012334/JAW.

From 4. workshop on integrity of containments for nuclear power plants; Washington, DC, USA (15 Jun 1988).

A parametric study of the containment response of the Grand Gulf plant, a Mark III BWR, has been conducted using the Contain code. The response to extensive debris dispersal following reactor pressure vessel failure at high pressure is examined for a short period after vessel failure, for plant conditions corresponding to a short-term station blackout scenario with water on the floor of the drywell. The discussion of results from this study focuses on the peak drywell-wetwell pressure difference, the peak pedestal pressure, and the potential for drywell flooding after debris dispersal.

43054 (SAND—88-1631C) **Evaluation of the performance of the Sequoyah Unit 1 containment under conditions of severe accident loading.** Miller, J.D.; Clauss, D.B. (Sandia National Labs., Albuquerque, NM (USA)). 1988. Contract AC04-76DP00789. 19p. (CONF-880616—2). NTIS, PC A03/MF A01; 1; GPO Dep. Order Number DE88012331/JAW.

From 4. workshop on integrity of containments for nuclear power plants; Washington, DC, USA (15 Jun 1988).

Based on experience with the 1:32-scale and 1:8-scale steel containment models, Sandia National Laboratories has developed analytical techniques for predicting the performance of LWR steel containment buildings subject to loads beyond the design basis. The current investigation is intended to demonstrate the application of these methods to a steel containment building for a licensed nuclear power plant; Sequoyah Unit 1 was chosen for reasons outlined in the paper. The identification and investigation of potential failure modes is documented. Details of the analysis for the containment shell behavior are provided, as well as a brief description of the evaluation of leakage potential for the equipment hatch.

43055 **Advanced ultrasonic failed fuel rod detection system.** Snyder, B.J.; Foerch, H. *Transactions of the American Nuclear Society;* 52: 60-62(1986). (CONF-860610—Summs.).

From American Nuclear Society annual meeting; Reno, NV, USA (15 Jun 1986).

The detection of failures in a fuel assembly has been accomplished by a number of techniques, including sampling the reactor coolant system during operations, sipping each assembly after discharge, eddy-current testing of removed fuel rods, and ultrasonic inspection. An advanced ultrasonic system developed by Brown Boveri (BBR) with the assistance of Krautkramer has been utilized to identify individual failed fuel rods. High reliability has been demonstrated in the rapid inspection of assemblies in the United States and overseas utilizing this system. Analyses have been done to demonstrate the benefits of fuel inspections for a number of applications.

43056 **Effect of rod consolidation on spent fuel disposal costs.** O'Brien, P.D. (Sandia National Lab., Albuquerque, NM (USA)). *Transactions of the American Nuclear Society;* 52: 63-64(1986). (CONF-860610—Summs.).

From American Nuclear Society annual meeting; Reno, NV, USA (15 Jun 1986).

The US Dept. of Energy (DOE) plans for the management of spent power reactor fuel are based on the assumption that individual fuel rods may be removed from the fuel assemblies and consolidated in close-packed arrays, thus reducing the number of waste containers to be disposed of. The reasoning is that it may cost less to develop, build, and operate the facilities and equipment required for consolidation than it would to buy, load, and emplace the extra containers required for the disposal of intact fuel assemblies. In its role supporting the DOE's Nevada Nuclear Waste Storage Investigations (NNWSI) project, Sandia National Laboratories has assessed the cost effectiveness of consolidation at a repository being considered for location in the tuff deposits at Yucca Mountain in Nye County, Nevada. For this study, it was assumed that all spent fuel is shipped to the repository as intact fuel assemblies. Costs were compared for two basic disposal options, one based on at-repository consolidation, the other based on disposal of intact fuel assemblies. For both options, mining, drilling, and emplacement costs were estimated for two emplacement configurations - single containers in vertical boreholes, and multiple containers in long, horizontal boreholes.

2102 Power Reactors, Non-breeding, Light-water Moderated, Non-boiling Water Cooled

REFER ALSO TO CITATION(S) 42813, 42826, 43049, 43051, 43055, 43056, 43111, 43119, 43171, 43173, 43175, 43180, 43186, 43187, 43192, 43193, 43195, 43221, 43222, 43223, 43233, 43235, 43236, 43237, 43246, 43249, 43922, 44524

43057 (CNEN-DR-GTT—04/87) **Utilization of a statistical procedure for DNBR calculation and in the survey of reactor protection limits.** Pontedeiro, A.C.; Camargo, C.T.M.; Galetti, M.R. da Silva. (Comissao Nacional de Energia Nuclear de Brasil, Rio de Janeiro. Dept. de Reatores). 1987. 139p. (In Portuguese). NTIS (US Sales Only), PC A07/MF A01. Order Number DE88703485/JAW.

A new procedure is applied to Angra 1 NPP, which is related to DNBR calculations, considering the design parameters statistically: Improved Thermal Design Procedure (ITDP). The ITDP application leads to the determination of uncertainties in the input parameters, the sensitivity factors on DNBR. The DNBR limit and new reactor protection limits. This was done to Angra 1 with the subchannel code COBRA-IIIP. The analysis of limiting accident in terms of DNB confirmed a gain in DNBR margin, and greater operation flexibility of the plant, decreasing unnecessary trips of the reactor.

43058 **(EPRI-NP—5541-Vol.1) Experimental prediction of tube support interaction characteristics in steam generators: Volume 1, Unmodified Westinghouse Model D-3 preheater region: Topical report.** Haslinger, K.K.; Martin, M.L. (Electric Power Research Inst., Palo Alto, CA (USA); Combustion Engineering, Inc., Windsor, CT (USA)). Jun 1988. 210p. Unlimited audience, publicly available. Research Reports Center, Box 50490, Palo Alto, CA 94303. Order Number TI88011932/JAW.

A multispan, single tube test fixture with up to eight instrumented supports (plus four non-instrumented) was fabricated which enabled accurate tube motion and tube-to-tube support interaction measurements on a Westinghouse Model D-3 economizer geometry. Both Window and Non-Window geometries were tested with detailed alignment conditions provided by Westinghouse. In both cases the tube was excited with independently controlled, biaxial random input motions that simulated the cross flow intensities previously determined by Westinghouse from a 2/3 scale flow model test program. In the subject experiments, measurements were recorded for the two tube models in air and water environments. The excitations intensity was varied to reflect 75 and 100 percent power conditions, as well as a hypothetical 140 percent power case. Data were digitally analyzed to compute statistically significant force, tube motion, tube sliding distance and, most importantly, work rate parameters for each instrumented support elevation. In addition, the observed tube motion and tube support interaction characteristics were documented in terms of orbital tube motion displays; time histories of excitation, tube motion and support reaction force functions; and in terms of energy spectra of tube motions and support reaction forces. A short section of the experimental forcing functions and of the corresponding tube motion and support reaction characteristics was digitized. The forcing functions were used by Westinghouse as input for a corresponding analysis run to enable direct comparisons between analytical and experimental wear prediction techniques for identical geometry (boundary) and excitation conditions. 17 refs., 67 figs., 26 tabs.

43059 **(EPRI-NP—5541-Vol.2) Experimental prediction of tube support interaction characteristics in steam generators: Volume 2, Westinghouse Model 51 flow entrance region: Topical report.** Haslinger, K.H. (Electric Power Research Inst., Palo Alto, CA (USA); Combustion Engineering, Inc., Windsor, CT (USA)). Jun 1988. 312p. Research Reports Center, Box 50490, Palo Alto, CA 94303. Order Number TI88012212/JAW.

Tube-to-tube support interaction characterisitics were determined experimentally on a single tube, multi-span geometry, representative of the Westinghouse Model 51 steam generator economizer design. Results, in part, became input for an autoclave type wear test program on steam generator tubes, performed by Kraftwerk Union (KWU). More importantly, the test data reported here have been used to validate two analytical wear prediction codes; the WECAN code, which was developed by Westinghouse, and the ABAQUS code which has been enhanced for EPRI by Foster Wheeler to enable simulation of gap conditions (including fluid film effects) for various support geometries.

43060 **(EPRI-NP—5570-Vol.1) Flow velocity and turbulence measurements in a Westinghouse D-4 steam generator model: Volume 1, Test report: Final report.** Witt, E.A. Jr.; Marhefka, B.F.; Delose, F. (Westinghouse Electric Corp., Pittsburgh, PA (USA). Water Reactor Divisions). Jun 1988. 100p. Unlimited audience, publicly available. Research Reports Center, Box 50490, Palo Alto, CA 94303;3. Order Number TI88011934/JAW.

Turbulence and velocity measurements were made in a 2/3-scale model of a D4 steam generator inlet waterbox. The instrumentation used for the measurements was a hot-film constant-temperature anemometer using X-oriented cylindrical sensors. The objective of the test was to determine turbulence levels and characteristics within the waterbox volume for the purpose of evaluation and use in the {open←quotes}GUST{close←quotes} computer code which predicts these parameters. The test was performed over a period of six months with difficulties arising in using the sensors for this application. The results of the test showed that while mean velocity measurements were difficult to directionalize, the magnitudes were consistent with prior velocity measurements made with pitot/static-type probes. In addition, turbulence intensity measurements indicated that as suspected, the waterbox flow is highly turbulent and that the turbulence level increases with proximity to the tube bank. A number of processed data functions were also generated. The Power Spectral Density (PSD) plots showed that the majority of the energy is contained in the low-frequency range (less than 100 Hz). It also appears that this energy is confined to pockets within the center portion of the model. Micro and Macro time scales from the Autocorrelation Functions (ACF) of the data confirm that the largest eddies correspond to areas of highest energy; namely the center of the model. Micro and Macro spatial scales in areas near the walls and tubes are very close, indicating lower energies. 6 refs., 39 figs., 6 tabs.

43061 **(EPRI-NP—5727) Corrosion-product filtration in PWRs: Topical report.** Balakrishnan, P.V.; Buckley, L.P. (Atomic Energy of Canada Ltd., Chalk River, Ontario. Chalk River Nuclear Labs.). Apr 1988. 60p. Research Reports Center, Box 50490, Palo Alto, CA 94303;1. Order Number TI88008579/JAW.

As part of a programme on the optimization of pressurized water reactor (PWR) secondary side water treatment, laboratory-scale studies on filtration of the feedwater using materials having chemically active adsorbing surfaces were carried out. Graphite, zirconia and titania were identified, from a review of existing literature, as suitable filtration media, the last two because of their ion-exchange capability. The efficiency of filters packed with granular graphite for filtration of simulated feed train corrosion products and the pressure drop across the filters were determined as functions of filter dimensions and operating parameters at room temperature. A rough sizing of a full-flow feedwater filter using granular graphite was done on the basis of observations from the room temperature tests. Further studies are suggested at low concentrations of the corrosion product and at high temperature typical of steam generator feedwater after the high pressure heaters to derive realistic design parameters for a filter for installation in the PWR secondary circuit. Zirconia was produced in the form of spherical particles using a sol-gel process. The zirconia behaved as an anion exchanger at low pH and as a cation exchanger at high pH. Its suitability for purification of water at high temperature should be determined by futher studies. 30 refs., 16 figs., 8 tabs.

43062 (IAEA-SR—110(bk.), pp 245-285) **Releases and storage of radioactive wastes at Angra 1 nuclear power plant from 1982 to 1985.** Kamel, N.H. (FURNAS, Rio de Janeiro (Brazil)). 1986. NTIS (US Sales Only), PC A99/MF A01. Order Number DE88702505/JAW. (CONF-861065—).

From Seminar on management options for low and intermediate level wastes in Latin America; Rio de Janeiro, Brazil (13 Oct 1986).

The relationship among the values foreseen, by the Angra 1 Final Safety Analysis Report - FSAR -, such as volume, and activities due to the liquid and gaseous wastes that should be released by Angra 1 and the real values of such releases from 1982 to 1985, is presented. The relationship between the value foreseen, by the manufacturer, due to solid waste to be generated and the solid waste really generated in this period is also shown. Finally, the relationship between the estimated doses to the individual and to population due to the liquid and gaseous wastes that should be released and the doses obtained due to the liquid and gaseous wastes really released, is shown. The doses obtained due to the liquid and gaseous wastes released, are compared with the dose limits established by Angra 1 Technical Specifications and CNEN - Resolucao 6/73.

43063 **(INIS-BR—1153) Materials concepts in PWR power plants. An overview.** Costa e Silva, A.L.V. (Instituto Brasileiro de Qualidade Nuclear, Rio de Janeiro). 1987. 44p. NTIS (US Sales Only), PC A03/MF A01. Order Number DE88703556/JAW.

Some measures to reduce the risk of exposure in case of nuclear accidents are presented. Some material questions concerning the integrity of reactor pressure vessel, the containment vessel and external systems are discussed. (E.G.).

43064 (INIS-mf—11110, pp 15-18) **REWET-project: experimental investigations of nuclear reactor safety.** Kalli, H.; Kervinen, T.; Purhonen, H.; Kouhia, J. (Lappeenranta Univ. of Technology (Finland). Dept. of Energy Technology;Valtion Teknillinen Tutkimuskeskus, Helsinki (Finland)). 1987. NTIS (US Sales Only), PC A03/MF A01. Order Number DE88780071/JAW. (CONF-8704277—).

From 8. scientific conference on power industry of the Ingenieurhochschule Zittau; Zittau, German D.R. (22 Apr 1987).

IHZ Wissenschaftliche Berichte.

The main experimental LOCA research program in Finland, the so-called REWET-project, is presented. The REWET facilities and the experiments carried out are described as well as the data acquisition system and the computer codes used for the analysis of the experiments.

43065 **PWR thermal hydraulics training facility for engineers and operators.** Caves, J.R.; Wehring, B.W.; Doster, J.M.; Turinsky, P.J. (North Carolina State Univ., Raleigh (USA)). *Transactions of the American Nuclear Society;* **52**: 17-18(1986). (CONF-860610—Summs.).

From American Nuclear Society annual meeting; Reno, NV, USA (15 Jun 1986).

The nuclear reactor program of the Nuclear Engineering Department at North Carolina State University has designed an operating model of a pressurized water reactor (PWR) nuclear steam supply system, referred to as the PWR Loop. The PWR loop will be used as a training facility in programs presented to utility reactor operators and engineers, as well as in undergraduate and graduate course work. The primary design criteria were: (a) maximize visualization of fluid flow regimes, (b) provide proper tracking of parameters of interest on specific transients, and (c) maintain the proper sequence of automatic protective actions, except when intentionally overridden.

43066 **Seminar on the organization and management of a commercial nuclear power project.** Peddicord, K.L.; Alvis, J.M.; Chitkara, K.K. (Texas A & M Univ., College Station (USA)). *Transactions of the American Nuclear Society;* **52**: 18(1986). (CONF-860610—Summs.).

From American Nuclear Society annual meeting; Reno, NV, USA (15 Jun 1986).

A main function of student branches of the American Nuclear Society (ANS) is to identify activities that contribute to the professional development and growth of its student members. Over the past several years, the ANS student branch at Texas A & M University has toured the construction site of the South Texas Nuclear Project (STNP), which is jointly owned by the Houston Lighting & Power Company (HL & P), the City of San Antonio, the Central Power & Light Company, and the City of Austin. This year, student branch organizers recognized that another aspect of a commercial nuclear power plant was not being covered either in the academic course work or the plant tours. This facet includes the organization and management required to undertake a major nuclear power project. To fill this gap, HL & P sponsored a one-day seminar that covered the various managerial functions for STNP. The seminar on the Organization and Management at a Commercial Nuclear Power Project was very interesting and beneficial. Other ANS branches and utilities may find this to be a useful model for future activities.

43067 **LPOP: loading pattern optimization program.** Morita, T.; Chao, Y.A.; Federowicz, A.J.; Duffy, P.J. *Transactions of the American Nuclear Society;* **52**: 41-42(1986). (CONF-860610—Summs.).

From American Nuclear Society annual meeting; Reno, NV, USA (15 Jun 1986).

An automated loading pattern optimization computer program, LPOP, has been developed and implemented for design applications at Westinghouse. A distinct feature of this program is its capability to predict the reactivity distribution required by any target power distribution and match the available assemblies accordingly. The program generates and analyzes a large number of loading patterns, which produce power distributions as close as possible to an input target power distribution.

2103 Power Reactors, Non-breeding, Graphite Moderated

REFER ALSO TO CITATION(S) 43103, 43111, 43170, 43190, 43197, 43198, 43199, 43200, 43201, 43202, 43203, 43204, 43205, 43206, 43207, 43208, 43209, 43210, 43211, 43212, 43213, 43214, 43215, 43224, 43225, 43226, 43227, 43228, 43229, 43474, 43527

43068 **(GA-A—19303) Designing a reactor for the next generation.** Neylan, A.; Dilling, D.; Ng, R. (General Atomic Co., San Diego, CA (USA)). May 1988. Contract AC03-88SF17367. 7p. (CONF-880702—16). NTIS, PC A02/MF A01; 1; GPO Dep. Order Number DE88012674/JAW.

From 23. intersociety energy conversion engineering conference; Denver, CO, USA (31 Jul 1988).

The Modular High-Temperature Gas-Cooled reactor (MHTGR) is an advanced reactor concept being developed under a cooperative program involving the US Government, the utilities and the nuclear industry. The design utilizes basic High-Temperature Gas-Cooled Reactor (HTGR) features of ceramic fuel, helium coolant, and a graphite moderator. The specific size and configuration is selected to utilize the inherent materials characteristics associated with these standard features to develop a passively safe design which provides a higher margin of safety and investment protection than current generation reactors. The MHTGR which is now into the preliminary design phase meets regulatory and new, more challenging user requirements. These challenges were met utilizing proven design concepts integrated through the application of a top-down systems and functional engineering approach. The resulting design has successfully undergone extensive regulatory, utility/user, and peer reviews. This paper outlines the requirements, describes the design and the current status, shows how the design meets the requirements, and looks at potential future deployment from the vendor's perspective.

43069 **(GA-A—19336) Design requirements for high-temperature metallic component materials in the US modular HTGR.** Shenoy, A.S.; Betts, W.S. (General Atomics Co., San Diego, CA (USA)). Jun 1988. Contract AC03-88SF17367. 22p. (CONF-8806156—1). NTIS, PC A03/MF A01; 1; GPO Dep. Order Number DE88011912/JAW.

From IAEA specialists meeting on high-temperature metallic materials for gas-cooled reactors; Cracow, Poland (20 Jun 1988).

The modular high temperature gas-cooled reactor (MHTGR) is a 350 MW(t) second generation reactor system design which during normal operation circulates helium with a mixed mean coal and hot temperature of 260°C (500°C) and 690°C (1270°F), respectively. The design incorporates passive design features which allow the plant to be safely shutdown and cooled with no active systems or operator action being required. A key feature of this concept is the capability of the residual heat removal by passive conduction cooldown from the core to the reactor cavity via an uninsulated vessel. The MHTGR uses a number of metallic components. A description of these components and their design requirements are presented in this paper.

43070 (INIS-BR—1003) **Chernobylsk and its environmental impacts-Some considerations about technical and legal aspects.** Malheiros, T.M.M.; Bomfim, L.F.S. do. (Associacao Brasileira de Direito Nuclear, Rio de Janeiro). 1987. 10p. (In Portuguese). (CONF-8706302—). NTIS (US Sales Only), PC A02/MF A01. Order Number DE88702587/JAW.

From 2. Brazilian congress on the environmental protection; Rio de Janeiro, Brazil (29 Jun 1987).

Several informations and, technical and scientific concepts related to nuclear energy, from the Chernobylsk accident and its economic, social and juridical consequences, are presented. The origins of the accident and consequences for environment are analysed. The questions such as prompt information of nuclear and radiological accidents passed to be regulated by international treaties caused, particularly, by the Chernobylsk accident, are shown. The transfrontier pollution and the civil liability of Russia by damages caused for the population of other countries, are discussed. Considerations about feed importation from Europe by Brazil, in particu-

lar, the milk, which has put in action several juridical processes, are done. (M.C.K.).

43071 (INIS-mf—11119, pp 21) **Increase of the exposure rate in the Netherlands caused by the reactor accident at Chernobyl. Document 7.** Stoutjesdijk, J.F. (Rijksinstituut voor Volksgezondheid en Milieuhygiene, Bilthoven (Netherlands)). Dec 1986. (In Dutch). NTIS (US Sales Only), PC A22/MF A01. Order Number DE88701754/JAW.

Tabs. .

In Documents, used for drawing up the CCRX-report 'Radioactive contamination in the Netherlands caused by the reactor accident at Chernobyl'. Part 1.

The exposure rate in the Netherlands is increased by the radioactive deposition in May 1986. The largest value of this increase was observed in Enschede: c.a. 20 μR/h above the normal local value of 6 μR/h. After the decay of the shortliving nuclides, early in June, the increase amounted c.a. 2 μR/h the dispersion width laying in between 0 and 4.3 μR/h. In the river forelands along Rhine/Waal, Maas and Dommel somewhat larger values have been found for this Chernobyl increase. 8 refs.; 8 figs.; 8 tabs.

43072 (INIS-mf—11210, pp IV1-IV4) **Israel's interest in HTGRs.** Greenspan, E. (Israel Atomic Energy Commission, Tel Aviv). Dec 1987. NTIS (US Sales Only), PC A13/MF A01. Order Number DE88780087/JAW. (CONF-871287—).

From Nuclear Societies of Israel annual meeting; Haifa, Israel (21 Dec 1987).

Transactions.; V. 14.

43073 (INIS-mf—11210, pp IV9-IV12) **Applications of high temperature reactors to Israeli shale processing.** Spiewak, I. (Weizmann Inst. of Science, Rehovoth (Israel)). Dec 1987. NTIS (US Sales Only), PC A13/MF A01. Order Number DE88780087/JAW. (CONF-871287—).

From Nuclear Societies of Israel annual meeting; Haifa, Israel (21 Dec 1987).

Transactions.; V. 14.

43074 (INIS-SU—10, pp 51-57) **Numerical calculation of dynamics of a NPP with high-temperature gas cooled reactor.** Kapustin, A.D.; Molodov, V.A. 1987. (In Russian). NTIS (US Sales Only), PC A05/MF A01. Order Number DE88780094/JAW.

Voprosy Atomnoj Nauki i Tekhniki.; (No. 2).

In Physics and technology of nuclear reactors.

Methods for investigating the dynamics of a NPP with solid reactor core and gaseous coolant, based on their mathematical model representation by a system of interconnected units, are proposed. Algorithms for numerical integration of a set of mathematical model subsystems is developed according to which an independent calculation of all the units is first of all performed at each time step and then the equation of these units' interconnection is solved. To calculate each type of units, an individual difference scheme, taking into account the subsystem equation specificity, is proposed.

43075 (JAERI-M—87-218) **Study on the reaction between SiC and Pd.** Namba, Takashi; Yamawaki, Michio; Minato, Kazuo; Fukuda, Kousaku. (Japan Atomic Energy Research Inst., Tokyo). Jan 1988. 21p. (In Japanese). NTIS (US Sales Only), PC A03/MF A01. Order Number DE88753427/JAW.

An out of pile experiment was performed on the corrosion of the SiC layer by fission product Pd in the Triso-coated fuel particles of high temperature gas-cooled reactor. The present experiment aimed at clarification of the corrosion mechanism with an emphasis on whether or not the pyrolytic carbon (PyC) layer is effective for the reduction of the corrosion rate. Simulated Triso-coated particles with different thicknesses of outer PyC layer (OPyC) were heated in the powder of Au-Pd alloy and the dependence of the reaction rate on time, temperature and OPyC thickness was studied. From the experimental results, the diffusion coefficient of Pd in the PyC layer was evaluated at 1300 deg C, which was found to be too large for the PyC layer to be a barrier against the Pd diffusion.

43076 (JAERI-M—88-031) **Evaluation of effective coolant flow rate in advanced design of the small scale VHTR core. For high performance of the 2nd stage of detailed design.** Fumizawa, Motoo; Suzuki, Kunihiko; Murakami, Tomoyuki. (Japan Atomic Energy Research Inst., Tokyo). Feb 1988. 56p. (In Japanese). NTIS (US Sales Only), PC A04/MF A01. Order Number DE88753431/JAW.

This report describes the evaluation of effective coolant flow rate in the advanced design of the small scale VHTR core. The analytical design study was carried out after the 2nd stage of detailed design in order to reduce the cost of construction. The summary of the analytical results are as follows: (1) Crossflow loss coefficient of flange type fuel block having 0.1 mm of sealing gap is about 100 times higher than that of dowel type block adopted in the 2nd stage of detailed design. (2) In case that coolant channel outer diameter is 52 mm and hydraulic diameter is 6 mm, the effective coolant flow rates using flange and dowel type fuel blocks are 80 % and 70 % respectively. Because the crossflow loss coefficients of dowel type are lower than that of flange type. (3) The effective coolant flow rate, when crossflow loss coefficients are distributed along with the axial direction, agrees well with that using mean value of crossflow loss coefficient i.e. 5×10^{11} m^{-4}.

2104 Power Reactors, Non-breeding, Otherwise Moderated Or Unmoderated

43077 (CONF-8804155—1) **Radial core expansion reactivity feedback in advanced LMRs: uncertainties and their effects on inherent safety.** Wigeland, R.A.; Moran, T.J. (Argonne National Lab., IL (USA)). 1988. Contract W-31-109-ENG-38. 24p. NTIS, PC A03/MF A01; 1; GPO Dep. Order Number DE88011944/JAW.

From Topical meeting on safety of next generation power reactors; Seattle, WA, USA (1 Apr 1988).

An analytical model for calculating radial core expansion, based on the thermal and elastic bowing of a single subassembly at the core periphery, is used to quantify the effect of uncertainties on this reactivity feedback mechanism. This model has been verified and validated with experimental and numerical results. The impact of these uncertainties on the safety margins in unprotected transients is investigated with SASSYS/SAS4A, which includes this model for calculating the reactivity feedback from radial core expansion. The magnitudes of these uncertainties are not sufficient to preclude the use of radial core expansion reactivity feedback in transient analysis.

2105 Power Reactors, Breeding

REFER ALSO TO CITATION(S) 43188, 43189, 43191

43078 (CEA-CONF—9346) **Design criteria for FBR core components.** Desprez, D.; Ravenet, A.; Bernard, A. (CEA Centre d'Etudes Nucleaires de Cadarache, 13 - Saint-Paul-les-Durance (France). Dept. des Reacteurs a Neutrons Rapides). 1987. 9p. (CONF-870917—). NTIS (US Sales Only), PC A02/MF A01. Order Number DE88753937/JAW.

From ANS/ENS international conference on fast breeder reactor systems: experience gained and path to economical power generation; Richland, WA, USA (13 Sep 1987).

This paper outlines the general approach adopted in France to take into account the specific behavior of irradiated steel for functional and structural verification of fast breeder reactor core components. Functional verification deals with the distortions which appear in structures as a result of void swelling and irradiation creep. Specific criteria must be defined to limit these distortions to acceptable values: these criteria are highly dependent on the subassembly and core design. Structural verification deals with modifications of the mechanical properties of steel submitted to FBR flux. Conventional standards and rules are not applicable, and a new methodology must be defined to take into account the new characteristics of irradiated steel. The general R and D program set up to investigate these areas is presented here as it is implemented in France but with emphasis on integration in a joint European program.

43079 **(CONF-880321—3) Time-series investigation of anomalous thermocouple responses in a liquid-metal-cooled reactor.** Gross, K.C.; Planchon, H.P.; Poloncsik, J. (Argonne National Lab., IL (USA)). 24 Mar 1988. Contract W-31-109-ENG-38. 11p. NTIS, PC A03/MF A01; 1; GPO Dep. Order Number DE88011990/JAW.

From SAS Users Group international (SUGI-13); Orlando, FL, USA (27 Mar 1988).

A study was undertaken using SAS software to investigate the origin of anomalous temperature measurements recorded by thermocouples (TCs) in an instrumented fuel assembly in a liquid-metal-cooled nuclear reactor. SAS macros that implement univariate and bivariate spectral decomposition techniques were employed to analyze data recorded during a series of experiments conducted at full reactor power. For each experiment, data from physical sensors in the tests assembly were digitized at a sampling rate of 2/s and recorded on magnetic tapes for subsequent interactive processing with CMS SAS. Results from spectral and cross-correlation analyses led to the identification of a flow rate-dependent electromotive force (EMF) phenomenon as the origin of the anomalous TC readings. Knowledge of the physical mechanism responsible for the discrepant TC signals enabled us to device and justify a simple correction factor to be applied to future readings.

43080 **(CONF-880748—6) Pattern-recognition system application to EBR-II plant-life extension.** King, R.W.; Radtke, W.H.; Mott, J.E. (Argonne National Lab., IL (USA); EI International, Inc., Idaho Falls, ID (USA)). 1988. Contract W-31-109-ENG-38. 12p. NTIS, PC A 03; 3; GPO Dep. Order Number DE88012043/JAW.

From American Nuclear Society topical meeting on nuclear power plant life extension; Snowbird, UT, USA (31 Jul 1988).

A computer-based pattern-recognition system, the System State Analyzer (SSA), is being used as part of the EBR-II plant-life extension program for detection of degradation and other abnormalities in plant systems. The SSA is used for surveillance of the EBR-II primary system instrumentation, primary sodium pumps, and plant heat balances. Early results of this surveillance indicate that the SSA can detect instrumentation degradation and system performance degradation over varying time intervals, and can provide derived signal values to replace signals from failed critical sensors. These results are being used in planning for extended-life operation of EBR-II.

43081 **(FEI—1845) Method for statistical calculation of a fast reactor core taking into account fuel assembly shape changes in the process of reactor operation.** Zhukov, A.V.; Sorokin, A.P.; Ushakov, P.A.; Bogoslovskaya, G.P.; Kriventsev, V.I.; Titov, P.A. (Gosudarstvennyj Komitet po Ispol'zovaniyu Atomnoj Ehnergii SSSR, Obninsk. Fiziko-Ehnergeticheskij Inst.). 1987. 16p. (In Russian). NTIS (US Sales Only), PC A03/MF A01. Order Number DE88703494/JAW.

A method of temperature field calculation in a fast reactor core, using the criterion of equal stability margine of fuel in different throttle areas, which takes into account changes in thermohydraulic characteristics of fuel assemblies in the process of operating cycle under the effect of the core degradation, redistribution of energy release, incidental arbitrary deviation of parameters, is presented. Distribution of statistical characteristics of temperature field in fuel assemblies is determined according to channel-by-channel technique of thermohydraulic calculation, taking into account intersubchannel exchange and peculiarities of the degradation effect on the fuel assembly temperature field with initial parameters, distributed on the basis of the Monte-Carlo method. Results of the calculations show that the degradation process can affect considerably the core temperature regime. The conclusion is made on the necessity of thermohydraulic analysis of the core during reactor operating cycle already at the stage of design studies and developments. 17 refs.; 5 figs.

43082 **Thermal conductivity of a bed of sheared, irradiated FFTF fuel.** Mailen, J.C. (Oak Ridge National Lab., TN (USA)). *Transactions of the American Nuclear Society;* **52**: 46-47(1986). (CONF-860610—Summs.).

From American Nuclear Society annual meeting; Reno, NV, USA (15 Jun 1986).

Sheared or broken fuel elements are routinely handled in fuel reprocessing and could be encountered occasionally in any fuel handling operation. The internal heat generated in beds of sheared or broken fuel as a result of decay may be important in certain cases and is usually calculated from correlations derived from tests using simulated beds of fuel. This paper reports experiments in which the thermal conductivities of sheared beds of irradiated fuel were determined from temperature profiles and then compared with those calculated by using a model.

2106 Power Reactors, Auxiliary, Mobile, Package, And Transportable

REFER ALSO TO CITATION(S) 43108, 43241

43083 **(N—88-21251) Power transmission studies for tethered SP100.** Bents, D.J. (National Aeronautics and Space Administration, Cleveland, OH (USA). Lewis Research Center). 1988. 16p. (NASA-TM—100864; E—4081; NAS—1.15:100864; CONF-880702—). NTIS, PC A03/MF A01.

From 23. intersociety energy conversion engineering conference; Denver, CO, USA (31 Jul 1988).

The tether and/or transmission line connecting the SP-100 to space station presents some unorthodox challenges in high voltage engineering, power transmission, and distribution. The line, which doubles as a structural element of this unusual spacecraft, will convey HVDC from SP-100 to the platform in low Earth orbit, and environment where the local plasma is sufficient to cause breakdown of exposed conductors at potentials of only a few hundred volts. Its anticipated several years operation, and continuously accumulating exposure to meteoroids and debris, raises an increasing likelihood that mechanical damage, including perforation, will be sustained in service. The present concept employs an array of gas insulated solid wall aluminum coaxial tubes; a conceptual design which showed basic feasibility of the SP-100 powered space station. Practical considerations of launch, deployment and assembly have lead to investigation of reel deployable, dielectric insulated coaxial cables. To be competitive, the dielectric would have to operate reliably in a radiation environment under electrical stresses exceeding 50 kV/cm. The SP-100 transmission line high voltage interfaces are also considered.

43084 **Feasibility assessment of nuclear reactor power system concepts for the NASA growth space station.** Bloomfield, H.S.; Heller, J.A. (National Aeronautics and Space Administration, Cleveland, OH (USA)). pp 79-91 of Space nuclear power systems, 1986: Volume 5. El-Genk, M.S.; Hoover, M.D. (eds.). Malabar, FL; ORBIT Book Company, Inc. (1987). (CONF-860102—).

From 3. symposium on space nuclear power systems; Albuquerque, NM, USA (13 Jan 1986).

A preliminary feasibility assessment of the integration of reactor power 8system concepts with a projected growth Space Station architecture was conducted to address a variety of installation, operational, disposition and safety issues. A previous NASA-sponsored study, which showed the advantages of Space Station-attached concepts, served as the basis for this study. A study methodology was defined and implemented to assess compatible combinations of reactor power installation concepts, disposal destinations, and propulsion methods. Three installation concepts that met a set of integration criteria were characterized from a configuration and operational standpoint, with end-of-life disposal mass identified. Disposal destinations that met current aerospace nuclear safety criteria were identified and characterized from an operational and energy requirements standpoint, with delta-V energy requirements as a key parameter. Chemical propulsion methods that met current and near-term application criteria were identified and payload mass and delta-V capabilities were characterized. These capabilities were matched against concept disposal mass and destination delta-V requirements to provide a feasibility of each combination.

43085 **Neutronics characteristics of space power reactors.** Little, W.W.; Barner, J.O. (Pacific Northwest Lab., Richland, WA (USA)). pp 95-99 of Space nuclear power systems, 1986: Volume 5. El-Genk, M.S.; Hoover, M.D. (eds.). Malabar, FL; ORBIT Book Company, Inc. (1987). (CONF-860102—).

From 3. symposium on space nuclear power systems; Albuquerque, NM, USA (13 Jan 1986).

This report presents a brief description of the neutronics characteristics of selected conceptual designs for space reactors. Parametric studies also are included to delineate the effects of possible design changes. Although a wide range of power densities and sizes is considered, the focus is on reactors that provide roughly 1 Mwt to 50 Mwt. Both ceramic (UO_2 and UN in clad pins) fueled reactors and cermet (Mo, W, and Ta matrix) fueled reactors are examined. Although ceramic fuels have become the standard for power reactors, cermet fuels exhibit several desirable attributes for space applications. These attributes include greater structural strength and a more reliable reactivity expansion coefficient.

43086 **SNPSAM: space nuclear power system analysis model.** El-Genk, M.S.; Seo, J.T. (Univ. of New Mexico, Albuquerque (USA)). pp 111-133 of Space nuclear power systems, 1986: Volume 5. El-Genk, M.S.; Hoover, M.D. (eds.). Malabar, FL; ORBIT Book Company, Inc. (1987). (CONF-860102—).

From 3. symposium on space nuclear power systems; Albuquerque, NM, USA (13 Jan 1986).

This research developed a Space Nuclear Power System Analysis Model (SNPSAM) for analyzing integrated thermoelectric (TE) SP-100 systems. SNPSAM is a modular computer model that takes into account the interactions and feedback processes among the system's major component. These components are the nuclear reactor, the primary coolant loop, the primary heat exchanger, the thermoelectric-electromagnetic (TE-EM) pump, the TE energy converter. Each component was modeled and verified individually before being coupled to the other models in the system. The users of SNPSAM can select between SiGe/GaP and SiGe for the TE generators both in the main TE converter and in the TE-EM pumps, and between liquid Lithium (Li) and NaK-78 for the primary coolant. SNPSAM was used to study the performance of the integrated TE SP-100 system during steady state and transient operation. The system's parameters during steady state operation were calculated as functions of the reactor thermal power and coolant type (Li or NaK-78). These operating parameters include the reactor core and coolant temperatures, the coolant mass flow rate and specific pumping power, and the overall thermal-to-electric conversion efficiency as well as the electric power output. The results showed that the TE SP-100 system is a nonlinear system and that the system's conversion efficiency and electric power output strongly depend on the reactor thermal power. This research also investigated the system's transient behavior following step and ramp external reactivity insertions into the reactor core.

43087 **Simulation of heat pipe rapid transient performance using a multi-nodal implicit finite difference scheme.** Peery, J.S.; Best, F.R. (Texas A & M Univ., College Station (USA)). pp 145-150 of Space nuclear power systems, 1986: Volume 5. El-Genk, M.S.; Hoover, M.D. (eds.). Malabar, FL; ORBIT Book Company, Inc. (1987). (CONF-860102—).

From 3. symposium on space nuclear power systems; Albuquerque, NM, USA (13 Jan 1986).

A model to simulate heat pipe rapid transients has been developed. This model uses a one-dimensional development of the continuity and momentum equations to solve for the velocity and pressure distributions in both the liquid and vapor regions. A two-dimensional development of the energy equation is used to determine the temperature distributions in the liquid and vapor regions, as well as in the walls of the heat pipe. The vapor and liquid regions are coupled through mass and energy transfer due to evaporation and condensation. The model used for this phenomenon is based on the physical conditions of the vapor and liquid for a given node. However, this model for evaporation and condensation not only causes the energy equation to be nonlinear but also constrains the time step to 10^{-4} seconds for convergence to be reached. The model has been run for small transients up to 2 seconds to produce temperature distributions and demonstrate the convergence difficulties associated with the evaporation/condensation model used.

43088 **Self-induced thermoelectric-electromagnetic pump model for SP-100 systems.** El-Genk, M.S.; Buksa, J.J.; Seo, J.T. (Univ. of New Mexico, Albuquerque, NM (USA)). pp 161-172 of Space nuclear power systems, 1986: Volume 5. El-Genk, M.S.; Hoover, M.D. (eds.). Malabar, FL; ORBIT Book Company, Inc. (1987). (CONF-860102—).

From 3. symposium on space nuclear power systems; Albuquerque, NM, USA (13 Jan 1986).

An integrated model of a self-induced, thermoelectric-electromagnetic (TE-EM) pump was developed. The model consists of three coupled models: an electromagnetic (EM) model, a two-dimensional thermal analysis model of the magnet, and a steady state/transient thermoelectric (TE) converter model. The integrated pump model incorporates the temperature-dependent magnetic properties of the magnetic material (Hiperco-27), as well as temperature dependent TE material properties (SiGe/GaP). Parametric analyses showed that the pressure head of the pump depends on the number of foils insulating the magnetic structure from the coolant flowing through the pump's ducts up to some asymptotic number of foils. Beyond this point, increasing the number of foils has no effect on the pump pressure head. For a given coolant circulation rate, the pump's pressure head and overall efficiency are strongly dependent on the coolant temperature and the conditions of the pump's radiator. Although a reduction in the heat rejection capability of the pump's radiator and/or a loss of one of the radiator's heat pipes significantly reduces the pump's pressure head and overall efficiency, it results in a slight increase in the magnetic flux density and the TE conversion efficiency.

43089 **High temperature thermoelectric energy conversion.** Wood, C. (California Institute of Technology, Pasadena (USA)). pp 175-186 of Space nuclear power systems, 1986: Volume 5. El-Genk, M.S.; Hoover, M.D. (eds.). Malabar, FL; ORBIT Book Company, Inc. (1987). (CONF-860102—).

From 3. symposium on space nuclear power systems; Albuquerque, NM, USA (13 Jan 1986).

The theory and current status of materials research for high-temperature thermoelectric energy conversion are reviewed. Semiconductors are shown to be the preferred class of materials for this application. Optimization of the figure of merit of both broad- and narrow-band semiconductors is discussed as a function of temperature. Phonon scattering mechanisms are discussed, and basic material guidelines are given for reduction of thermal conductivity. Two general classes of materials show promise for high temperature figure of merit (Z) values, namely the rare earth chalcogenides and the boron-rich borides. The electronic transport properties of the rare earth chalcogenides are explicable on the basis of degenerate or partially degenerate n-type semiconductors. Boron and boron-rich borides exhibit p-type hopping conductivity, with detailed explanations proposed for the transport differing from compound to compound. Some discussion is presented on the reasons for the low thermal conductivities in these materials. Also, ZTs greater than one appear to have been realized at high temperature in many of these compounds.

43090 **Analysis of the transient behavior of thermoelectric generators.** El-Genk, M.S.; Seo, J.T. (Univ. of New Mexico, Albuquerque (USA)). pp 187-198 of Space nuclear power systems, 1986: Volume 5. El-Genk, M.S.; Hoover, M.D. (eds.). Malabar, FL; ORBIT Book Company, Inc. (1987). (CONF-860102—).

From 3. symposium on space nuclear power systems; Albuquerque, NM, USA (13 Jan 1986).

This research developed and verified a steady state/transient model for thermoelectric (TE) generators. The model takes into account the change in the material properties with temperature and handles any combination of boundary conditions at the hot and cold shoes of the TE generator. The model was verified by comparing its predictions with the available exact solutions for simplified boundary conditions, and by performing an energy balance on the TE generator. Finally, the model was used to investigate the

steady state and transient behavior of radiatively cooled SiGe/GaP TE generators.

43091 **Monolithic fuel cell based power source for burst power generation.** Fee, D.C.; Bhattacharyya, S.K.; Busch, D.E.; Carlson, L.W.; Claar, T.D.; Dees, D.W.; Dusek, J.; Easler, T.E.; Ellingson, W.A.; Flandermeyer, B.K.; Fousek, R.J. (Argonne National Lab., IL (USA)). pp 209-214 of Space nuclear power systems, 1986: Volume 5. El-Genk, M.S.; Hoover, M.D. (eds.). Malabar, FL; ORBIT Book Company, Inc. (1987). (CONF-860102—). Contract W-31-109-ENG-38.

From 3. symposium on space nuclear power systems; Albuquerque, NM, USA (13 Jan 1986).

A unique fuel cell coupled with a low power nuclear reactor presents an attractive approach for Strategic Defense Initiative (SDI) burst power requirements. The high power, long duration bursts, quoted in the open literature, (100 MWe, 200 s) appear achievable within a single shuttle launch limitation with appropriate development of the concept.

43092 **Composite aluminum conductors for pulsed power applications at liquid hydrogen temperatures.** Ho, J.C.; Oberly, C.E.; Gegel, H.L. (Wichita State Univ., KS (USA)). pp 233-241 of Space nuclear power systems, 1986: Volume 5. El-Genk, M.S.; Hoover, M.D. (eds.). Malabar, FL; ORBIT Book Company, Inc. (1987). (CONF-860102—).

From 3. symposium on space nuclear power systems; Albuquerque, NM, USA (13 Jan 1986).

High-purity, stress-free aluminum has extremely low electrical resistance at liquid hydrocarbon temperatures and strong magnetic fields. A composite conductor constructed with this high-purity, fine-filament material can allow fast current penetration to the filaments embedded in a high-electrical, low-thermal-resistance matrix to minimize loss problems. This composite conductor can be effectively used in pulsed power applications where liquid hydrogen is available, and where liquid helium normally needed for superconducting devices is absent. Major manufacturing concerns require that the matrix material have workability compatible with that of aluminum and practically zero impurity diffusion to ensure the high purity of aluminum filaments in the final product. They report favorable results of a feasibility study on fabricating such a composite conductor. An aluminum-base alloy containing iron and cerium, recently developed as a high-temperature material with dispersion strengthening, was used as the matrix material. It satisfies most of the aforementioned requirements. Using a streamlined die, billets of this alloy with pure aluminum inserts were successfully extruded in steps. Processing parameters were selected based on results of computer-aided processing simulation.

43093 **Cryogenic aluminum-wound generator rotor concept for nuclear power conversion.** Schlicher, R.L.; Oberly, C.E. (Air Force Weapons Lab., Kirtland Air Force Base, NM (USA)). pp 243-248 of Space nuclear power systems, 1986: Volume 5. El-Genk, M.S.; Hoover, M.D. (eds.). Malabar, FL; ORBIT Book Company, Inc. (1987). (CONF-860102—).

From 3. symposium on space nuclear power systems; Albuquerque, NM, USA (13 Jan 1986).

This paper presents a design outline for a liquid hydrogen cooled generator rotor that could be used to fabricate a 20-megawatt cryogenic generator. The armature of an existing 20-megawatt superconducting generator could be utilized in this new cryogenic generator concept without electrical modification and with minimum modification to its housing. The acquisition and operating expense of liquid helium liquefiers, refrigeration requirements and the expense of fabricating a superconductor wound generator rotor make an aluminum-wound rotor a viable alternative. Ideally, the aluminum rotor could use the higher cryogenic temperatures of liquid hydrogen at 21 K as conductor coolant and not require the more difficult fabrication techniques of a superconducting generator rotor. A most likely conductor candidate is high purity aluminum which has 0.2% its room temperature resistance at liquid hydrogen temperatures. Recent research has indicated the feasibility of fabricating high-purity aluminum conductors in a composite conductor form.

43094 **Inorganic dielectric insulation for superconductors and conventional conductors in space reactor environments.** Gupta, T.K.; Lawless, W.N.; Oberly, C.E.; Bich, G.J.; Wagner, G.R.; Holmes, D.S. (Alcoa Labs., PA (USA)). pp 249-256 of Space nuclear power systems, 1986: Volume 5. El-Genk, M.S.; Hoover, M.D. (eds.). Malabar, FL; ORBIT Book Company, Inc. (1987). (CONF-860102—).

From 3. symposium on space nuclear power systems; Albuquerque, NM, USA (13 Jan 1986).

The need for high current, stable superconductors had led to the development of Nb_3Sn as the most promising candidate for use in superconducting machines. However, its brittle nature of and the high reaction temperature (973 K) required to form it preclude the use of standard organic insulation systems. A recently developed class of high temperature dielectric materials, which are characterized by unusually large specific heats and thermal conductivities at cryogenic temperatures, offers increased enthalpy stabilization in a super-conducting winding, as well as the required dielectric strength. In recent years, the Air Force supported a series of programs to develop a film-type dielectric insulation system for superconductors using these materials incorporated in a glassy matrix. The development of this composite insulation system is described in this paper and its application is extended to ordinary conductors for space nuclear power systems.

43095 **Expert systems for space power supply: design, analysis, and evaluation.** Cooper, R.S.; Thomson, M.K.; Hoshor, A. (Apogee Research Corp., San Diego, CA (USA)). pp 259-266 of Space nuclear power systems, 1986: Volume 5. El-Genk, M.S.; Hoover, M.D. (eds.). Malabar, FL; ORBIT Book Company, Inc. (1987). (CONF-860102—).

From 3. symposium on space nuclear power systems; Albuquerque, NM, USA (13 Jan 1986).

The authors evaluated the feasibility of applying expert systems to the conceptual design, analysis, and evaluation of space power supplies in particular, and complex systems in general. To do this, they analyzed the space power supply design process and in associated knowledge base, and characterized them in a form suitable for computer emulation of a human expert. The existing expert system tools and the results achieved with them were evaluated to assess their applicability to power system design. They applied some new concepts for combining program architectures (modular expert systems and algorithms) with information about the domain to create a deep system for handling the complex design problem. They authors developed, programmed and tested NOVICE, a code to solve a simplified version of a scoping study of a wide variety of power supply types for a broad range of missions, as a concrete feasibility demonstration.

43096 **Observations on the as-welded (GTAW) bend ductility of Mo-13%Re alloy.** Ammon, R.L.; Buckman, R.W. Jr. (Westinghouse Electric Corp., Pittsburgh, PA (USA)). pp 283-289 of Space nuclear power systems, 1986: Volume 5. El-Genk, M.S.; Hoover, M.D. (eds.). Malabar, FL; ORBIT Book Company, Inc. (1987). (CONF-860102—).

From 3. symposium on space nuclear power systems; Albuquerque, NM, USA (13 Jan 1986).

The ductile-to-brittle transition (DBTT) behavior of Mo-13% Re alloy sheet was evaluated in bending. Recrystallized material and as-GTA welded materials were tested. GTA welding raised the DBTT from 200 K to 450 K. This rise can be attributed primarily to the large grain size of the fusion/heat-affected zones. However, recrystallized 50% Mo-50% Re alloy exhibited minimal change in DBTT as a result of GTA welding. Although dilute rhenium additions to molybdenum enhance low-temperature ductility of both wrought and recrystallized material, the ductilizing effect appears to be minimized in the as-GTA welded condition.

43097 **Irradiation swelling in self-ion irradiated niobium.** Bajaj, R.; Shiels, S.A.; Hall, B.O.; Fenske, G.R. (Westinghouse Electric Corp., Pittsburgh, PA (USA)). pp 305-314 of Space nuclear power systems, 1986: Volume 5. El-Genk, M.S.; Hoover, M.D. (eds.). Malabar, FL; ORBIT Book Company, Inc. (1987). (CONF-860102—).

From 3. symposium on space nuclear power systems; Albuquerque, NM, USA (13 Jan 1986).

This paper presents initial results of an investigation of swelling mechanisms in a model body centered cubic (bcc) metal, niobium, irradiated at elevated temperatures (0.3 T/sub m/ to 0.6 T/sub m/) where T/sub m/ = melting point in K. The objective of this work is to achieve an understanding of the elevated temperature swelling in bcc metals, which are the prime candidate alloys and composite matrix materials for space reactor applications. Niobium was irradiated with 5.3 MeV Nb^{++} ions, at temperatures ranging from 700°C to 1300°C, to a nominal dose of 50 dpa at a dose rate of 6×10^{-3} dpas. Swelling was observed over a temperature range of 700°C to 1200°C, with a peak swelling of 7% at 900°C. The microstructural data, obtained from transmission electron microscopy, were compared to the predictions of the theoretical model developed during this program. A reasonable agreement was obtained between the experimental measurements of swelling and theoretical predictions by adjusting both the niobium-oxygen binding energy and the incubation dose for swelling to realistic values.

43098 **Radiation damage analysis for state-of-the-art microelectronics.** Lazo, M.S.; Woodall, D.M.; McDaniel, P.J. (Univ. of New Mexico, Albuquerque (USA)). pp 317-322 of Space nuclear power systems, 1986: Volume 5. El-Genk, M.S.; Hoover, M.D. (eds.). Malabar, FL; ORBIT Book Company, Inc. (1987). (CONF-860102—).

From 3. symposium on space nuclear power systems; Albuquerque, NM, USA (13 Jan 1986).

Space nuclear power systems will demand a high degree of reliability and operability, requiring advanced in the performance of electronic subsystems. The single most important factor limiting the lifetime and operability of such components is the radiation environment they will encounter. In this paper the authors address the improvement of computational capabilities to determine the physical damage due to radiation in microelectronic materials. Using the NJOY nuclear data processing code, they predict the neutron radiation damage response function of semiconductor materials. This includes the prediction of displacement and ionization damage due to the interaction of high-energy neutrons or gamma radiation. The authors have made calculations of neutron response functions for pure silicon and for silicon dioxide, and the results are presented here. The methodology developed included using the Lindhard electronic screening theory to compute the distribution of damage between ionization and displacement. The variation of those results with a primary knock-on atom (PKA) is of significance for a molecule such as SiO_2. The methodology of doing such molecular damage calculations is presented here. This work was performed on a VAX 11/780 computer using the VMS operating system.

43099 **Radiation and high temperature effects of MOSFETS.** Lin, T.J.; Wu, C.H.; Kumar, A.S. (Univ. of Missouri, Rolla (USA)). pp 323-331 of Space nuclear power systems, 1986: Volume 5. El-Genk, M.S.; Hoover, M.D. (eds.). Malabar, FL; ORBIT Book Company, Inc. (1987). (CONF-860102—).

From 3. symposium on space nuclear power systems; Albuquerque, NM, USA (13 Jan 1986).

The effects of gamma-ray irradiation and high temperature environments on MOSFETs (Metal-Oxide-Semiconductor Field Effect Transistors) were investigated to a maximum gamma dose of 10 Mrad(Si) and a maximum temperature of 200°C. The drain-source current and gate voltage characteristics were studied before and after irradiation and after annealing. A kinetic model of recovery by thermal annealing that takes into account the random potential barriers between silicon-oxide interface is presented. The model is different in concept from the previous thermally activated tunneling model of Winokur et al (1984). The kinetic model explains satisfactorily the annealing behavior of radiation damage in MOSFETs as observed in these experiments as well as those of a previous study by Danchenko et (1980).

43100 **Gigarad-tolerant power switches and memory elements.** Joyner, W.T.; Becknell, G.F.; Donelson, J.M.A. (Hampden-Sydney College, VA (USA)). pp 333-339 of Space nuclear power systems, 1986: Volume 5. El-Genk, M.S.; Hoover, M.D. (eds.). Malabar, FL; ORBIT Book Company, Inc. (1987). (CONF-860102—).

From 3. symposium on space nuclear power systems; Albuquerque, NM, USA (13 Jan 1986).

A new class of silicon devices operating without p-n junctions has been studied for radiation hardness. The electric field in these devices is uniform over most of the device, thus causing high-voltage breakdown to increase with electrode spacing. Deep acceptor levels are created in the silicon by diffusing gold atoms into the lattice, or by electron radiation. These acceptor levels, near the center of the band gap, trap out electrons so that the low resistivity of the n-type doped wafer can be raised to intrinsic resistivity. Switching between a high-resistivity state at low currents and a low-resistivity state at high currents occurs at a definite threshold voltage, exhibiting characteristics similar to silicon-controlled rectifiers. Compensating 0.1 ohm-meter (10 ohm-cm) silicon wafers requires electron fluxes of 10^{23} electrons per square meter (10^{19} electrons per square centimeter). Experiments demonstrating gamma tolerance to 1 Gigarad(Si) are described. Calculations for maximum tolerable neutron fluence are shown, and a phenomenological explanation for these results is presented.

43101 **Recent BeO-reflector-controlled reactor experiments in ZPPR.** McFarlane, H.F.; Brumbach, S.B.; Carpenter, S.G.; Collins, P.J.; McKnight, R.D. (Argonne National Lab., Idaho Falls, ID (USA)). pp 343-356 of Space nuclear power systems, 1986: Volume 5. El-Genk, M.S.; Hoover, M.D. (eds.). Malabar, FL; ORBIT Book Company, Inc. (1987). (CONF-860102—). Contract W-31-109-ENG-38.

From 3. symposium on space nuclear power systems; Albuquerque, NM, USA (13 Jan 1986).

Integral reactor physics measurements were performed on a BeO-reflected fast reactor assembly in the ZPPR facility during January and February of 1985. The measurements emphasized power distributions and reflector control worths in two different critical states. The measurements have been analyzed using three-dimensional deterministic and Monte Carlo methods and the ENDF/B-V.2 nuclear data library. Together the measurements and analyses form a modern, reliable, benchmark data set for testing calculational methods that will be used in predicting some of the design parameters for future space reactors.

43102 **Pegasus drive: a multimegawatt nuclear electric propulsion system.** Coomes, E.P.; Cuta, J.M.; Webb, B.J.; King, D.Q. (Pacific Northwest Lab., Richland, WA (USA)). pp 365-373 of Space nuclear power systems, 1986: Volume 5. El-Genk, M.S.; Hoover, M.D. (eds.). Malabar, FL; ORBIT Book Company, Inc. (1987). (CONF-860102—). Contract AC06-76RL01830.

From 3. symposium on space nuclear power systems; Albuquerque, NM, USA (13 Jan 1986).

A propulsion system (The PEGASUS Drive) consisting of a magnetoplasmadynamic (MPD) thruster driven by a multi-megawatt nuclear power system is proposed as the propulsion system for a manned Mars mission. The propulsion system described is based on a mission profile containing a 51-day burn time (for a mission time of approximately 1000 days). Electric propulsion systems have significant advantages over chemical systems, because of high specific impulse, lower propellant requirements, and lower system mass. The thermal power for The PEGASUS Drive is supplied by a boiling liquid-metal fast reactor. The system consists of the reactor, reactor shielding, power conditioning, heat rejection, and MPD thruster subsystems. It is capable of providing a maximum of 8.5 megawatts of electrical power of which 6 megawatts is needed for the thruster system, 1.5 megawatts is available for spacecraft system operations and in flight mission applications, leaving the balance for power system operation.

43103 **Particle bed reactor propulsion vehicle performance and characteristics as an orbital transfer rocket.** Horn, F.L.; Powell, J.R.; Lazareth, O.W. (Brookhaven National Lab., Upton, NY (USA)). pp 375-381 of Space nuclear power systems, 1986: Volume 5. El-Genk, M.S.; Hoover, M.D. (eds.). Malabar, FL; ORBIT Book Company, Inc. (1987). (CONF-860102—).

From 3. symposium on space nuclear power systems; Albuquerque, NM, USA (13 Jan 1986).

The particle bed reactor designed for 100-MW to 300-MW power output using hydrogen as a coolant is capable of specific impulses up to 1000 seconds as a nuclear rocket. A single space shuttle compatible vehicle can perform extensive missions from LEO (Low Earth Orbit) to 3 times GEO (Geosynchronous Earth Orbit) and return with multi-ton payloads. The use of hydrogen to directly cool particular reactor fuel results in a compact, lightweight rocket vehicle whose duration of usefulness is dependent only upon hydrogen resupply availability. The LEO to GEO mission has a payload capability of 15.4 tons with 3.4 meters of shuttle bay. To increase the volume limitation of the shuttle bay, ammonia is used in the initial boost phase from LEO to give greater payload volume with a small decrease in payload mass, 8.7 meters and 12.7 tons. The reactor fuel elements consist of HTGR-type fuel particles 700 micrometers in diameter held between coaxial porous metal or ceramic frits forming annular elements through which coolant gas flows radially. Nineteen of these elements are arranged in a reactor core matrix with a canned ^{7}LiH moderator between them, forming a thermal reactor. the nominal core size is 40-cm diameter by 60-cm length, with a 5-cm liquid H_2 reflector. The incoming hydrogen gas flows through holes in the moderator cooling the moderator before entering the thin inlet plenum around each fuel element. The gas flows radially inward through the frits and packed particle bed exiting along the central channel of each element. The neutronic studies indicate a fuel loading of about 4.5 kg of ^{235}U when the reflector hydrogen temperature is maintained at 112 K.

43104 **Space based nuclear-microwave electric propulsion.** Nordley, G.D.; Brown, W.C. (Air Force Rocket Propulsion Lab., Edwards Air Force Base, CA (USA)). pp 383-395 of Space nuclear power systems, 1986: Volume 5. El-Genk, M.S.; Hoover, M.D. (eds.). Malabar, FL; ORBIT Book Company, Inc. (1987). (CONF-860102—).

From 3. symposium on space nuclear power systems; Albuquerque, NM, USA (13 Jan 1986).

Electric propulsion can move more mass through space than chemical propulsion due to the higher exhaust velocities generated by electric propulsion devices. This performance is achieved at the expense of very heavy power sources or very long trip times, which, in turn, create technical and economic penalties of varying severity. These penalties include higher operations costs, delayed availability of the payload, and increased exposure to Van Allen Belt radiation. It is proposed to reduce these penalties by separating the power source from the propulsion device and using microwave energy beaming technology as an extension cord. This technology was recently explored and partially developed/tested for Solar Power Satellite concept studies. The advantages of this approach include reducing the specific power of the electric propulsion system power supply to 2kg/kW or less, reducing the vulnerability to radiation in comparison with solar cell electric propulsion systems, sharing the cost of the power generation hardware among many missions without returning the hardware each mission, eliminating or reducing the shadowing power losses in low orbit, and eliminating the safety concerns inherent with a maneuvering nuclear power source. This paper summarizes the state of the art of the technology needed for space-based beamed microwave power transmission, takes a preliminary look at some of the cost/performance trade-offs involved with the use of beamed microwave/electric propulsion for some typical orbit transfer missions, and offers some suggestions for addition work.

43105 **Burnup versus criticality limitations for a potential space reactor design in the 1 to 100 MWt range.** Voss, S.S.; McDaniel, P.J.; Woodall, D.M. (Los Alamos National Lab., NM (USA)). pp 427-434 of Space nuclear power systems, 1986: Volume 5. El-Genk, M.S.; Hoover, M.D. (eds.). Malabar, FL; ORBIT Book Company, Inc. (1987). (CONF-860102—).

From 3. symposium on space nuclear power systems; Albuquerque, NM, USA (13 Jan 1986).

In the design of large multimegawatt nuclear reactors for space a number of variables need to be optimized to achieve both the desired lifetime and size goals. The main purpose of this study was to identify the main lifetime limitors to the reactor core at enrichment levels of 45%, to 97%, for both beryllium and graphite reflectors and for power levels of 1, 10, and 100 MWt. A particulate fuel design was used for the study because it could easily span the intended power range and operate at the required high temperature levels. At higher power levels loss of reactivity control was shown to be the major lifetime limitor, not the fuel burnup. Possible ways of increasing lifetimes include incore breeding, burnable poisons, and internal control elements.

43106 **Brayton dynamic isotope power systems update.** Davis, K.A.; Pietsch, A.; Casagrande, R.D. (Garrett Fluid Systems Co., Tempe, AZ (USA)). pp 469-482 of Space nuclear power systems, 1986: Volume 5. El-Genk, M.S.; Hoover, M.D. (eds.). Malabar, FL; ORBIT Book Company, Inc. (1987). (CONF-860102—).

From 3. symposium on space nuclear power systems; Albuquerque, NM, USA (13 Jan 1986).

Brayton dynamic power systems are uniquely suited for space applications. They are compact and highly efficient; offer inherent reliability through the use of only one moving part, a rotor mounted on gas bearings; and utilize a single-phase and inert working fluid. Brayton power systems for space applications have been under development since 1962. The first Brayton Cycle Demonstrator (BCD) hardware, funded by the Garrett Corporation in 1962, provided the proof-of-principle demonstration. Subsequently, the NASA, USAF, USN, DARPA, AEC, and DOE have been sponsors of this work. The foil gas bearing version of the Brayton Rotating Unit (BRU), designated the BRU-F, was developed under NASA LeRC sponsorship and was the forerunner of the Mini-BRU. The Mini-BRU, developed under a NASA/DOE joint venture program, became the Brayton Isotope Power System (BIPS) in a program (Brayton Isotope Power System phase I) completed by Garrett Ai-Research in 1978. This paper describes the salient features of the BIPS as a Dynamic Isotope Power System (DIPS), summarizes the development work to date, establishes the maturity of the design, provides an update on materials technology, and reviews systems integration considerations.

2107 Regulation And Licensing

REFER ALSO TO CITATION(S) 43230, 43231, 43243

43107 **(CNEN-NE—6.02) Licensing of radiactive installations.** (Comissao Nacional de Energia Nuclear de Brasil, Rio de Janeiro). Oct 1984. 27p. (In Portuguese). NTIS (US Sales Only), PC A03/MF A01. Order Number DE88703486/JAW.

The procedure for licensing radioative installations related to localization, construction, operation and modifications is presented. (E.G.).

43108 **(NUREG—0540-Vol.10-No.2) Title list of documents made publicly available, February 1-29, 1988.** (Nuclear Regulatory Commission, Washington, DC (USA). Div. of Publications Services). Apr 1988. 347p. NTIS, PC A15/MF A01;1. Order Number TI88008433/JAW.

This document is a monthly publication containing descriptions of information recieved and generated by the US Nuclear Regulatory Commission (NRC). This information includes: (1) docketed material associated with civilian nuclear power plants and other uses of radioactive materials; and (2) nondocketed material received and generated by NRC pertinent to its role as a regulatory agency. The following indexes are included: Personal Author, Corporate Source, Report Number, and Cross Reference to Principal Documents.

43109 **(NUREG—0750-Vol.27-No.4) Nuclear Regulatory Commission issuances.** (Nuclear Regulatory Commission, Washington, DC (USA). Div. of Freedom of Information and Publications Services). Apr 1988. 155p. NTIS, PC A08/MF A01 - GPO. Order Number TI88012682/JAW.

This report includes the issuances received during the specified period from the Commission (CLI), the Atomic Safety and Licensing Appeal Boards (ALAB), the Atomic Safety and Licensing Boards (LBP), the Administrative Law Judge (ALJ), the Directors' Decisions (DD), and the Denials of Petitions for Rulemaking (DPRM).

43110 (NUREG—0940-Vol.6-No.4) **Enforcement actions: Significant actions resolved: Quarterly progress report, October-December 1987.** (Nuclear Regulatory Commission, Washington, DC (USA). Office of Enforcement). Feb 1988. 219p. NTIS, PC A10/MF A01 - GPO;1. Order Number TI88900630/JAW.

This compilation summarizes significant enforcement actions that have been resolved during one quarterly period (October{endash} December 1987) and includes copies of letters, Notices, and Orders sent by the Nuclear Regulatory Commission to licensees with respect to these enforcement actions. It is anticipated that the information in this publication will be widely disseminated to managers and employees engaged in activitites licensed by the NRC, so that actions can be taken to improve safety by avoiding future violations similar to those described in this publication.

2108 Economics

REFER ALSO TO CITATION(S) 43072, 43073, 43117, 43286, 43287

43111 (INIS-mf—11210, pp IV5-IV8) **Review of the economics of HTGRs.** Barak, A.Z. (Israel Atomic Energy Commission, Tel Aviv). Dec 1987. NTIS (US Sales Only), PC A13/MF A01. Order Number DE88780087/JAW. (CONF-871287—).

From Nuclear Societies of Israel annual meeting; Haifa, Israel (21 Dec 1987).

Transactions.; V. 14.

43112 **At-reactor storage expansion options.** Fuierer, A.A. *Transactions of the American Nuclear Society;* **52**: 62-63(1986). (CONF-860610—Summs.).

From American Nuclear Society annual meeting; Reno, NV, USA (15 Jun 1986).

Under the Nuclear Waste Policy Act of 1982, the US Dept. of Energy (DOE) is responsible for spent fuel beginning in 1998. Planned storage capacity at many reactors, ~ 30, will not be adequate to accommodate expected discharges until 1998. The number of plants requiring additional storage is rising dramatically with program delays that are becoming ever more certain. Therefore, planning to provide additional storage capacity beyond that which currently exists, and is planned, will be required. Although DOE has proposed construction of a monitored retrievable storage (MRS) facility to accommodate program delays, there remains uncertainty that DOE will be able to receive fuel by 1998 for several reasons. One finds that there are several opportunities for cost-effective at-reactor storage capacity additions. Rod consolidation potentially heads the list after re-rack, and opens the way for new economical storage technologies and systems.

22 NUCLEAR REACTOR TECHNOLOGY

43113 (INIS-mf—11119, pp 10) **Nuclear power installations in Europe. Document 20.** Kuile, C.R. ter; Dijk, E. van. (Rijksinstituut voor Volksgezondheid en Milieuhygiene, Bilthoven (Netherlands)). Dec 1986. (In Dutch). NTIS (US Sales Only), PC A22/MF A01. Order Number DE88701754/JAW.

Tabs. .

In Documents, used for drawing up the CCRX-report 'Radioactive contamination in the Netherlands caused by the reactor accident at Chernobyl'. Part 1.

A survey is given of nuclear power plants in Europe up to the Ural, updated up to July 1986. 6 refs.; 2 figs.

43114 **Nuclear engineering education in the United States: a status report.** Miller, D.W.; Spinrad, B.I. (Ohio State Univ., Columbus (USA)). *Transactions of the American Nuclear Society;* **52**: 9-10(1986). (CONF-860610—Summs.).

From American Nuclear Society annual meeting; Reno, NV, USA (15 Jun 1986).

The executive summary of the White Paper entitled The Revitalization of Nuclear Energy Education in the United States is the major component of this paper. The White Paper was completed under the auspices of the Nuclear Engineering Department Heads Organization (NEDHO). The presentation highlights events and program changes that have occurred in 1985-1986 following publication of the NEDHO White Paper. Many of these events provide optimism for the revitalization of nuclear engineering education.

43115 **Directions in nuclear research and development: a national laboratory perspective.** Jackson, J.F. (Los Alamos National Lab., NM (USA)). *Transactions of the American Nuclear Society;* **52**: 12(1986). (CONF-860610—Summs.).

From American Nuclear Society annual meeting; Reno, NV, USA (15 Jun 1986).

The national laboratories in the United States have been heavily involved in nuclear-related activities ranging from basic science to energy and weapons development. Advanced fission and fusion energy activities have been closely coupled to overall energy development plans, and related budgets, maintained by the US Dept. of Energy (DOE) and its predecessor organizations. These plans are undergoing significant changes at the present time, with consequent changes in the laboratory programs. Although it is difficult to predict the future in this relatively unstable environment, the purpose of this paper is to examine perceived trends and speculate on some of the directions and challenges that are likely to face those working in the national laboratories nuclear R & D programs in the next decades.

43116 **Challenges and opportunities for the class of 1990: an industry perspective.** Burchill, W.E. *Transactions of the American Nuclear Society;* **52**: 12-13(1986). (CONF-860610—Summs.).

From American Nuclear Society annual meeting; Reno, NV, USA (15 Jun 1986).

The year 1990 presents a symbolic transition from the first era of commercial nuclear power in the United States to eras that will follow. The last commercial nuclear power plant order by a domestic utility was in 1978. Based on a domestic construction schedule shown historically to last as much as 12 yr, this would mean that construction of all plants currently on order would be completed by 1990. Furthermore, it is generally agreed that the next domestic order for a new nuclear power plant will occur during the decade of the 1990s. Thus, 1990 can be considered to be the conjunction of two major eras in the domestic application of nuclear energy.

43117 **Nuclear utility education and training becoming too plant specific?.** Wicks, F. *Transactions of the American Nuclear Society;* **52**: 20(1986). (CONF-860610—Summs.).

From American Nuclear Society annual meeting; Reno, NV, USA (15 Jun 1986).

As the Supervisor of a university nuclear reactor and operations curriculum, the author has also been offering education and training programs for nuclear utility technical support and operations personnel. Similar results have been reported by other universities offering similar programs. These programs also provide very important benefits to university nuclear engineering departments in terms of much needed revenues during this time of declining student enrollment and also by the information flow from the nuclear utility participants to the university personnel, which can yield both improved courses and identify research opportunities. University programs serve an important complementary function to plant-specific programs and should be continued and supported.

2201 Theory And Calculation

43118 (AECL—8955) **WIMS-CRNL: A user's manual for the Chalk River version of WIMS.** Donnelly, J.V. (Atomic Energy of Canada Ltd., Chalk River, Ontario. Chalk River Nuclear Labs.). Jan 1986. 87p. NTIS (US Sales Only), PC A05/MF A01. Order Number DE88702487/JAW.

This report describes the preparation of the input for WIMS-CRNL, the Chalk River version of the WIMS lattice code. Also included are notes on the operation of the code, contents of the associated libraries, and the relation of WIMS-CRNL to other versions of the code.

43119 (INIS-mf—11044, pp 71-90) **SAMURA-ININ-ID-CODE.** Hernandez Callejas, R. (Instituto Nacional de Investigaciones Nucleares, Mexico City). 1985. (In Spanish). NTIS (US Sales Only), PC A07/MF A01. Order Number DE88780072/JAW. (CONF-8508261—).

From Seminar of the Division of Materials and Testing; Salazar, Mexico (23 Aug 1985).

The SAMURA CODE of the mechanical and thermal behaviour of light water reactor fuel rods is analyzed and evaluated.

43120 (INIS-mf—11210, pp V1-V3) **Accurate multigroup cross sections for resonance reactions.** Rothenstein, W. (Technion-Israel Inst. of Tech., Haifa. Dept. of Nuclear Engineering). Dec 1987. NTIS (US Sales Only), PC A13/MF A01. Order Number DE88780087/JAW. (CONF-871287—).

From Nuclear Societies of Israel annual meeting; Haifa, Israel (21 Dec 1987).

Transactions.; V. 14.

43121 (INIS-mf—11210, pp V8-V11) **Equivalence method for resonance shielding calculations in duplex pellet rod lattices.** Carmona, S.; Segev, M. (Israel Atomic Energy Commission, Yavne. Soreq Nuclear Research Center; Ben-Gurion Univ. of the Negev, Beersheba (Israel)). Dec 1987. NTIS (US Sales Only), PC A13/MF A01. Order Number DE88780087/JAW. (CONF-871287—).

From Nuclear Societies of Israel annual meeting; Haifa, Israel (21 Dec 1987).

Transactions.; V. 14.

43122 (INIS-mf—11210, pp V65-V67) **Collapsed cross-section in different eigenvalue-type formulation of Boltzman equation.** Shayer, Z. (Israel Atomic Energy Commission, Tel Aviv. Licensing Div.). Dec 1987. NTIS (US Sales Only), PC A13/MF A01. Order Number DE88780087/JAW. (CONF-871287—).

From Nuclear Societies of Israel annual meeting; Haifa, Israel (21 Dec 1987).

Transactions.; V. 14.

43123 (INIS-SU—10, pp 47-50) **Program package for determining the boundary of NPP stability region in the space of reactivity coefficients.** Znyshev, V.V.; Nikolaev, M.Ya.; Novikova, L.V.; Sinyavskij, V.V. 1987. (In Russian). NTIS (US Sales Only), PC A05/MF A01. Order Number DE88780094/JAW.

Voprosy Atomnoj Nauki i Tekhniki.; (No. 2).

In Physics and technology of nuclear reactors.

The GOUKOR program package (FORTRAN, BESM-6 computer), allowing one to calculate stability region boundary in the space of NPP reactivity coefficients, is developed. Transfer functions, which may be obtained experimentally or by calculating the NPP mathematical model under low perturbations, when the model nonlineary effect becomes disregardingly low, are necessary for the package operation. Transfer functions are assigned at several points and in the package they are interpolated either in piecewise manner or by cubical splines. Evaluation of the error effect in the transfer function representation on the transmission function calculation error is performed. It is shown, that transfer function interpolation by cubical splines as compared to the piecewise interpolation allows one to reduce the number of points, assigning the transfer functions without reducing the transmission function calculation accuracy.

43124 **Challenge for the next decade and beyond: a perspective from a member of the class of 1990.** Jansen, J.; Peddicord, K.L. (Texas A & M Univ., College Station (USA)). *Transactions of the American Nuclear Society;* **52**: 10-11(1986). (CONF-860610—Summs.).

From American Nuclear Society annual meeting; Reno, NV, USA (15 Jun 1986).

In considering the future from the viewpoint of a person will be embarking on a professional career in 1990, nuclear power will offer a variety of opportunities and challenges through the next decade and into the next century. Since nuclear energy has only been a viable power option since about 1950, for a nuclear engineer whose active career may run to the year 2040, the possibilities seem nearly limitless. This is true since this field of engineering affects many different areas of our lives, ranging from power to medicine and from environmental effects to space programs. Following 1990, nuclear energy will become an even more integral part of our lives.

43125 **Congressional perspective on the prospects for tomorrow's nuclear engineers.** Lloyd, M. *Transactions of the American Nuclear Society;* **52**: 11-12(1986). (CONF-860610—Summs.).

From American Nuclear Society annual meeting; Reno, NV, USA (15 Jun 1986).

This paper reviews in some detail the nature of the directions in the federally supported nuclear energy research program and discusses the potential opportunities in nuclear engineering education to make contributions to the nation's nuclear power research efforts. The potential impacts of deficit reduction measures on the budgets for nuclear fission programs are also described and the subcommittee priorities for the DOE nuclear fission program within the budget framework are discussed.

43126 **Neutron flux determination for arbitrarily distributed spatial sources.** Keffer, J.; Ganapol, B.D. (Univ. of Arizona, Tucson (USA)). *Transactions of the American Nuclear Society;* **52**: 14-15(1986). (CONF-860610—Summs.).

From American Nuclear Society annual meeting; Reno, NV, USA (15 Jun 1986).

A highly accurate numerical solution of the one-group time-dependent neutron transport equation in infinite plane geometry has recently been developed. The computer code can be used to solve for the scalar flux as a function of time and position resulting from an isotropic delta function source. The objective of this paper is to use the previous solution as a Green's function in the solution for the scalar flux resulting from an arbitrarily distributed source in space in plane geometry.

43127 **Reevaluation of the case, de Hoffman, and Placzek one-group neutron transport benchmark solution in plane geometry.** Ganapol, B.D. (Univ. of Arizona, Tucson (USA)). *Transactions of the American Nuclear Society;* **52**: 15-17(1986). (CONF-860610—Summs.).

From American Nuclear Society annual meeting; Reno, NV, USA (15 Jun 1986).

In a course on neutron transport theory and also in the analytical neutron transport theory literature, the pioneering work of Case et al. (CdHP) is often referenced. This work was truly a monumental effort in that it treated the fundamental mathematical properties of the one-group neutron Boltzmann equation in detail as well as the numerical evaluation of most of the resulting solutions. Many mathematically and numerically oriented dissertations were based on this classic monograph. In light of the considerable advances made both in numerical methods and computer technology since 1953, when the historic CdHP monograph first appeared, it seems appropriate to reevaluate the numerical benchmark solutions found therein with present-day computational technology. In most transport theory courses, the subject of proper benchmarking of numerical algorithms and transport codes is seldom addressed at any great length. This may be the reason that the benchmarking procedure is so rarely practiced in the nuclear community and when practiced is improperly applied. In this presentation, the development of a new benchmark for the one-group neutron flux in an infinite medium will be detailed with emphasis placed on the educational aspects of the benchmarking activity.

2202 Components And Accessories

REFER ALSO TO CITATION(S) 43234, 43593, 44289

43128 **(CEGB-TPRD/B—0988/R87) Use of boron trifluoride and alkoxiboroxines as extinguishers for magnesium alloy fires.** Newman, R.N. (Central Electricity Generating Board, Berkeley (UK). Berkeley Nuclear Labs.). Nov 1987. 12p. NTIS (US Sales Only), PC A03/MF A01. Order Number DE88753841/JAW.

The extinguishants currently available for putting out magnesium alloy fires work by covering the burning fuel and excluding both the oxygen and nitrogen from the reaction zone. It has been reported that boron trifluoride and trimethoxi-and tributoxi-boroxine may act in a more specific chemical way on the combustion reactions. In this report an investigation into the effectiveness of these compounds on magnesium alloy fires is described.

43129 (EPRI-NP—5490-SR) **Nondestructive Evaluation Program: Progress in 1987.** Avioli, M.J. Jr.; Dau, G.J.; Edmonds, J.; Gehl, S.; Liu, S.N.; Stein, J.; Viswanathan, R.; Welty, C.S. (Electric Power Research Inst., Palo Alto, CA (USA); Coe Corp., Sunnyvale, CA (USA)). Jun 1988. 389p. Research Reports Center, Box 50490, Palo Alto, CA 94303. Order Number TI88012214/JAW.

The increasing cost of equipment for power generating plants and the potential increases in productivity and safety available through rapidly developing Nondestructive Evaluation (NDE) technology led EPRI to initiate a Nondsetructive Evaluation Program in 1974. To date, the major focus has been on light water reactor inspection problems; however, increased application to other systems is now under way. This report presents a comprehensive review of the EPRI effort in the NDE area. Most of the report consists of contractor-supplied progress reports on each current project. An organization from several viewpoints is presented, e.g., in-service inspection operators, R&D personnel, and utility representatives. As the ninth in a planned series of annual progress reports of EPRI-funded NDE activities, this report also serves as the proceedings of the Eighth Annual EPRI NDE Information Meeting held in Palo Alto, California, on November 17-18, 1987. It summarizes significant progress made since the previous EPRI Special Report NP-4902-SR was issued in July 1987. Section 1 contains information about the program organization, and the sections that follow contain contractor-supplied progress reports on each current project. The progress reports are grouped by plant components{emdash}pipe, pressure vessel, steam generator and boiler tubes, and turbine. In addition, Part 6 is devoted to discussions of technology transfer. The individual reports have been cataloged separately.

43130 (EPRI-NP—5490-SR, pp 2.1-2.3) **Introduction (pipe and nozzle).** Jun 1988. Research Reports Center, Box 50490, Palo Alto, CA 94303. Order Number TI88012214/JAW.

In Nondestructive Evaluation Program: Progress in 1987.

Work conducted in this program consists of separate but related projects whose essential aim is to provide fieldable products (both hardware and software) that improve the reliability and economics of in-service inspections. The specific objectives are to: adapt or modify existing techniques for inspecting cast austenitic stainless steel (CASS) components; demonstrate the benefit of automated pipe inspection; develop appropriate mathematical models for ultrasonic inspection of power plant components; and adapt or evaluate new NDE methods for applications in the electric utility industry. Piping inspection activities in 1987 varied considerably from those of 1986 owing to some emerging issues. The status of these inspection activities is discussed.

43131 (EPRI-NP—5490-SR, pp 5.1-5.2) **Application of medical UT technology to the utility industry.** Neeley, V.I. (Vintek, Inc., Richland, WA (USA)). Jun 1988. Research Reports Center, Box 50490, Palo Alto, CA 94303. Order Number TI88012214/JAW.

In Nondestructive Evaluation Program: Progress in 1987.

During the past decade, EPRI has recognized the need for improved ultrasonic inspection, flaw characterization, and sizing, and has been active in sponsoring research and development to upgrade this technology. Examples include ultrasonic holography, isometric imaging, tomography, ALN, UDRPS, and IntraSpect. Real-time ultrasonic imaging has been a goal of all of these advanced ultrasonic systems; however, no industrial real-time ultrasonic imaging system has yet reached this level of sophistication. Meanwhile, the medical industry has successfully introduced real-time ultrasonic imaging into many of its disciplines and today uses this technology as a common diagnostic practice. Significant research and development has been devoted to the advancement of medical instrumentation, and today these instruments are considerably advanced over their industrial counterparts. The objectives of this program have been to evaluate the current state-of-the-art of industrial and medical real-time ultrasonic imaging systems and to recommend procedures for pursuing the development of an ultrasonic phased-array imaging system for nuclear utility inspection applications.

43132 (EPRI-NP—5490-SR, pp 6.1-6.13) **Ultrasonic wave scattering and characterization: centrifugally cast stainless steel.** Rose, J.L.; Pilarski, A.; Tverdokhlebov, A.; Balasubramaniam, K.; Da-Le, J. (Drexel Univ., Philadelphia, PA (USA)). Jun 1988. Research Reports Center, Box 50490, Palo Alto, CA 94303. Order Number TI88012214/JAW.

In Nondestructive Evaluation Program: Progress in 1987.

Of recent concern in nondestructive evaluation is the importance of inspecting anisotropic material. The anisotropic nature of centrifugally cast stainless steel (CCSS) used in the nuclear industry is discussed. There exists significant skew angle variations of 15 degrees or more at times that can cause serious problems in defect detection, location, classification, and sizing. With recent advances in the understanding of wave propagation in anisotropic media associated with critical angle refractivity, surface waves, plate waves, and longitudinal and shear wave scattering employing a newly developed point source Green's function numerical integration model, there exists an excellent chance that, once a material's characteristics are known with respect to its anisotropic character, a very accurate and a detailed defect classification analysis could be carried out. All the rules that exist today for studying defects in homogeneous isotropic media can most likely be extended to the anisotropic problem if the material characteristics are clearly established. The purpose of this work is to outline a numerical integration ultrasonic field analysis computation model and also to illustrate a variety of different experimental and analytical techniques that could be used to characterize the anisotropic nature and hence the corresponding grain structure associated with centrifugally cast stainless steel.

43133 (EPRI-NP—5490-SR, pp 7.1-7.6) **Evaluation of phased-array technology for the inspection of cast stainless steel.** Light, G.M.; Bloom, E.A. (Southwest Research Institute, San Antonio, TX (USA)). Jun 1988. Research Reports Center, Box 50490, Palo Alto, CA 94303. Order Number TI88012214/JAW.

In Nondestructive Evaluation Program: Progress in 1987.

For the past several years, growing concern has been expressed by various factions of the nuclear power industry regarding the effectiveness of ultrasonic techniques used for in-service inspection. The ability to examine austenitic (stainless steel) materials has been of particular concern, owing the difficulties associated with the acoustic properties of some of these materials. One particular category of austenitic material, cast stainless steel (CSS), presents special difficulties because of the large grain structure in its final product form. This property also results in a high fracture toughness, so CSS has often been selected for use in main reactor-coolant piping systems. This includes the commonly used Westinghouse pressurized-water reactor systems. A study entitled Evaluation of Phased-Array Technology for the Inspection of Cast Stainless Steel, to study how the use of linear phased-array transducers would enhance the inspection of cast stainless steel (CSS) is described. Results of the study are summarized.

43134 (EPRI-NP—5490-SR, pp 8.1-8.5) **Field application of feature-enhanced imaging.** Mucciardi, A.N. (Structural Integrity Associates, Inc., San Jose, CA (USA)). Jun 1988. Research Reports Center, Box 50490, Palo Alto, CA 94303. Order Number TI88012214/JAW.

In Nondestructive Evaluation Program: Progress in 1987.

One of the more challenging ultrasonic inspection problems is bimetallic weld inspection or, in general, dissimilar metal welds. These types of welds involve complicated geometries and various mixtures of materials. Attempts to address this problem with imaging alone have fallen short of desired goals. The probable reason for this is the lack of information supplied by imaging systems, which are limited to amplitude and time displays. Having RF information available for analysis greatly enhances the information obtainable from dissimilar metal welds and, coupled with the spatial map generated by an imaging system, can significantly improve the reliability of dissimilar metal weld inspections. Ultra Image and

TestPro are, respectively, an imaging system and a feature-based signal analysis system. The purpose of this project is to integrate these two systems to produce a feature-enhanced imaging system. This means that a software link is established between Ultra Image and the PC-based TestPro system so that the user of the combined system can perform all the usual imaging functions and also have available a wide variety of RF signal analysis functions. The analysis functions include waveform feature-based pattern recognition as well as artificial intelligence/expert system techniques.

43135 (EPRI-NP—5490-SR, pp 9.1-9.19) **Ultrasonic inspection and microstructural characterization of centrifugally cast stainless steel.** Saniie, J.; Bilgutay, N.M.; Avioli, M.J. Jr. (Illinois Institute of Technology, Chicago (USA)). Jun 1988. Research Reports Center, Box 50490, Palo Alto, CA 94303. Order Number TI88012214/JAW.

In Nondestructive Evaluation Program: Progress in 1987.

Centrifugally cast stainless steel (CCSS) components are currently being used in many critical industrial applications such as nuclear reactors, which have stringent inspection requirements. The manufacturing process of such components results in unique microstructural patterns consisting of large columnar grains with nonrandom growth directions and isotropic equiaxial grains. Consequently, the ultrasonic inspection of CCSS components is limited due to high attenuation by scattering, mode conversion, beam divergence/convergence, and skewing. The ultrasonic backscattered signal has poor signal-to-noise ratio (SNR) and consists of random and interfering grain noise which often masks the echoes received from defects caused by stress corrosion, thermal and mechanical fatigue. The ability to detect such defects is at best limited with the conventional non-destructive evaluation techniques. Some novel ultrasonic signal processing techniques involving both temporal and spectral methods are examined to improve the microstructure characterization and flaw detection capabilities. The research objectives are two-fold: (1) to reduce the background noise from the CCSS microstructure in order to improve flaw visibility, and (2) to determine signal parameters which can be correlated with the microstructural properties of the CCSS components.

43136 (EPRI-NP—5490-SR, pp 10.1-10.16) **Detection and sizing of large-scale cracks in centrifugally cast stainless steel pipes using Lamb waves.** Ngoc, T.D.K.; Avioli, M.J. Jr. (Georgetown Univ., Washington, DC (USA)). Jun 1988. Research Reports Center, Box 50490, Palo Alto, CA 94303. Order Number TI88012214/JAW.

In Nondestructive Evaluation Program: Progress in 1987.

Application of conventional ultrasonic nondestructive evaluation (NDE) techniques to centrifugally cast stainless steel (CCSS) pipes in pressurized water reactors (PWRs) has been limited, mainly due to the anisotropy of the CCSS materials. Phenomena such as beam skewing and distortion are directly attributable to this anisotropy and cause severe difficulties in crack detection and sizing. To improve CCSS inspectability, the feasibility of using Lamb waves as the probing mechanism for detecting and characterizing a surface-breaking crack originating from the pipe interior surface is discussed. A similar research effort has been reported by Rokhlin who investigated the interaction of Lamb waves with delaminations in thin sheets. Rokhlin and Adler also reported recently on the use of Lamb waves for evaluating spot welds. The motivation for using this probing mechanism derives from the recognition that the difficulties introduced by beam skewing, beam distortion, and high attenuation are circumvented, since Lamb waves are not bulk waves, but are resonant vibrational modes of a solid plate.

43137 (EPRI-NP—5490-SR, pp 11.1-11.8) **Modeling ultrasonic inspection of nuclear components: beam models and applications.** Thompson, R.B.; Achenbach, J.D.; Avioli, M.J. Jr. (Ames Lab., IA (USA)). Jun 1988. Research Reports Center, Box 50490, Palo Alto, CA 94303. Order Number TI88012214/JAW.

In Nondestructive Evaluation Program: Progress in 1987.

Achieving reliable inspection of nuclear components requires the development, and proper field implementation, of a variety of ultrasonic techniques. Because of advances in ultrasonic technology and concerns with ever-changing potential failure modes of aging reactors, new inspection techniques are constantly undergoing development and validation. The costs of a purely experimental approach to this process can be excessive, owing to sample fabrication, measurement and data interpretation, and destructive analysis. This project is concerned with the development and application of models that will help reduce these costs by providing theoretical guidance. The project has several major thrusts. The first has been to improve models for the evolution of ultrasonic field patterns as a beam propagates through a component. A particularly important aspect of the work has been the extension of the models to anisotropic materials, such as are found in certain weldments and cast stainless steels. The second is the continued development of a model for the ultrasonic response of intergranular stress corrosion cracks (IGSCC), as is needed to evaluate various detection and sizing procedures. Finally, an experimental program has been conducted to evaluate the performance of these theoretical models. Once validated, these models can be used to predict the performance of proposed inspection techniques. The development of these models is discussed.

43138 (EPRI-NP—5490-SR, pp 12.1-12.11) **Development of a finite element model for ultrasonic NDT phenomena.** Lord, W. (Colorado State Univ., Fort Collins (USA)). Jun 1988. Research Reports Center, Box 50490, Palo Alto, CA 94303. Order Number TI88012214/JAW.

In Nondestructive Evaluation Program: Progress in 1987.

Ultrasonic NDT techniques are used extensively in the nuclear industry for the detection and characterization of defects in critical structural components such as pressure vessels and piping. The feasibility of applying finite element analysis methods to the problem of modeling ultrasound/defect interactions has been shown. Considerable work remains to be done before a full three-dimensional model is available for the prediction of realistic ultrasonic transducer signals from sound wave interaction with arbitrarily shaped defects in highly attenuative and anisotropic materials. However, a two-dimensional code has been developed that is capable of predicting finite aperture ultrasonic transducer signals associated with wave propagations in isotropic materials and that shows good qualitative agreement with corresponding experimental observations. This 2-D code has now been extended to include anisotropic materials such as centrifugally cast stainless steel (CCSS), a necessary step in the development of the full 3-D code. Results are given showing the capability of the 2-D code to predict the anomalous wave behavior normally associated with ultrasonic wave propagation in anisotropic materials. In addition, a new signal processing technique is discussed, based on the Wigner transformation, that shows promise for application to centrifugally cast stainless steel NDT problems.

43139 (EPRI-NP—5490-SR, pp 13.1-13.2) **Fabrication of Inconel 182 weldments with environmentally induced axial stress corrosion cracks.** Walker, W.L. (GE Nuclear Energy Business Operation, San Jose, CA (USA)). Jun 1988. Research Reports Center, Box 50490, Palo Alto, CA 94303. Order Number TI88012214/JAW.

In Nondestructive Evaluation Program: Progress in 1987.

Nuclear Regulatory Commission requirements for NDE qualification have been tightened to include qualification on actual cracked specimens, rather than specimens with EDM notches and drilled holes. In the past, the emphasis has been on specimens of type 304 stainless steel with intergranular stress corrosion cracking in weld heat-affected zones. More recently, interdendritic stress corrosion cracking of Inconel 182 welds has been observed in operating BWRs and a need has arisen for laboratory specimens of this type. EPRI has addressed this need in the past with the production of 0.75-in.- and 1.5-in.-thick specimens, but these were relatively small specimens that did not incorporate the geometric considerations associated with large-diameter weldments. To overcome the shortcomings of the earlier specimens, a full-size 28-in.-diameter nozzle-to-recirculation pipe weld mockup will be prepared with environmentally induced interdendritic stress corrosion cracking in the Inconel 182 weldment. The current program consists of three phases: demonstration of the acoustic invisibility of weld-incorporated implants; production of environmental interdendritic stress corrosion cracks in 0.5-in.- and 0.75-in.-thick Inconel 182 weldments; and incorporation of cracked sections of the small specimens into the full-size Inconel 182 weldment between 4-in.-long rings of

A508 Class 2 low-alloy steel and type 316L stainless steel. The fabrication of these weldments is described.

43140 (EPRI-NP—5490-SR, pp 14.1-14.12) **Further evaluation of a new gamma scanning method for detection and sizing of intergranular stress corrosion cracking.** Heald, J.D. (S. Levy Inc., Campbell, CA (USA)). Jun 1988. Research Reports Center, Box 50490, Palo Alto, CA 94303. Order Number TI88012214/JAW.

In Nondestructive Evaluation Program: Progress in 1987.

Results are presented of an ongoing EPRI Project to develop and test a new nondestructive examination (NDE) concept for use in detection and sizing of intergranular stress corrosion cracking (IGSCC) in boiling water reactors (BWRs). This new NDE approach is based on collimated gamma scan measurements that are made from the outside surface of the piping. Cracks are detected and sized by characterizing the relative changes that occur in the measured gamma scan signals as a function of crack location and size.

43141 (EPRI-NP—5490-SR, pp 15.1-15.2) **Evaluation of technology improvement of an enhanced NDE imaging system.** Dobrzynski, W.J. (General Electric Co., San Jose, CA (USA)). Jun 1988. Research Reports Center, Box 50490, Palo Alto, CA 94303. Order Number TI88012214/JAW.

In Nondestructive Evaluation Program: Progress in 1987.

An enhanced NDE imaging system was evaluated for field hardenability at the Brunswick I reactor site during the spring 1987 outage. The enhanced imaging system is a result of interfacing the data acquisition and signal analysis capabilities of the PC-based TestPro system to the GE SMART UT system, which utilizes the Ultra Image III. TestPro is a personal computer (PC)-based software and hardware system that provides for ultrasonic RF waveform data acquisition and analysis. The analysis is based on features of the waveform as used by pattern recognition algorithms. The enhanced NDE imaging system is described.

43142 (EPRI-NP—5490-SR, pp 17.1-17.16) **Application of the cylindrically guided wave technique for bolts and pump shafts.** Light, G.M.; Bloom, E.A. (Southwest Research Institute, San Antonio, TX (USA)). Jun 1988. Research Reports Center, Box 50490, Palo Alto, CA 94303. Order Number TI88012214/JAW.

In Nondestructive Evaluation Program: Progress in 1987.

Over the past several years, nuclear power plants have expressed concern about failures of bolting, valve stems, and pump shafts. The development of an ultrasonic technique to inspect these components is discussed. The development and demonstration of the cylindrically guided wave technique (CGWT) on a wide range of stud bolts are described. The CGWT employs zero-degree longitudinal waves constrained to travel within the boundary of the cylindrically shaped components during inspection. Theoretically explained, mode conversion occurs because the ultrasonic wave is guided down the length of the component. These mode-converted signals are dependent upon the diameter of the component under inspection and the longitudinal and shear-wave velocities of the component material.

43143 (EPRI-NP—5490-SR, pp 19.1-19.7) **Fabrication of BWR pressure vessel NDE performance demonstration mockups.** Ramsey, P.R. (General Electric Co., San Jose, CA (USA)). Jun 1988. Research Reports Center, Box 50490, Palo Alto, CA 94303. Order Number TI88012214/JAW.

In Nondestructive Evaluation Program: Progress in 1987.

The purpose of this program is to provide reactor pressure vessel (RPV) test blocks containing induced flaws whose shape, size, and orientation are known and documented. The blocks will be used to qualify ultrasonic testing procedures, examiners, and equipment for inspecting RPV welds and vessel nozzle inner radii. Heretofore, there has been no requirement for qualification of personnel, equipment, and procedures together. Equipment performance checks are required by Regulatory Guide 1.150 for the purpose of improving flaw sizing repeatability. Procedure qualification has been performed by the user, either in his laboratory or on site in demonstrations to the ANII. A draft Regulatory Guide and a draft ASME Section XI addressing the requirements for personnel, equipment, and procedure qualification are now being circulated. Establishment of a full qualifications program by EPRI will greatly benefit the nuclear industry. It will provide a uniform method for qualification that is in compliance with regulatory and ASME Code requirements, and will provide one organization with overall responsibility. In addition to compliance considerations, this is deemed the most cost-effective approach for the industry as a whole.

43144 (EPRI-NP—5490-SR, pp 20.1-20.5) **Nondestructive examination through coatings.** Cook, J.F. (EG & G Idaho, Inc., Idaho Falls (USA)). Jun 1988. Research Reports Center, Box 50490, Palo Alto, CA 94303. Order Number TI88012214/JAW.

In Nondestructive Evaluation Program: Progress in 1987.

Nondestructive examination methodology for metal containment structures and for liners of concrete containment structures would be improved if the ASME Code rules for containment examination were modified to recognize surface examination techniques, if proved suitable, for use on painted surfaces. Documentation of tests of surface examination technique capabilities will aid in obtaining approval of revised Code rules. This program was initiated in response to concerns about the Section XI, Subsection IWE, rules for metal containment structures that rely only on visual examinations of painted surfaces to detect containment structural problems. This means that internal degradation will not be detected until it is manifested in damage to the external painted surface. Methods of testing capabilities of techniques for examination through painted surfaces have to date varied extensively, and thus the results also vary widely. The results of an analytical model of the magnetic particle examination AC yoke technique are presented.

43145 (EPRI-NP—5490-SR, pp 21.1-21.9) **Progress summary on the reliability of magnetic particle inspection performed through coatings.** Goldberg, L. (Sea Test Services, Merritt Island, FL (USA)). Jun 1988. Research Reports Center, Box 50490, Palo Alto, CA 94303. Order Number TI88012214/JAW.

In Nondestructive Evaluation Program: Progress in 1987.

A research project to investigate the reliability of magnetic particle inspection through coatings is described. The project specifically addresses the impact of ASME Code Section XI, Subsection IWE, Rules for Metal Containment Structures by the regulatory agency. The goal of the research is to determine and quantify the reliability of surface inspection techniques through coatings, specifically the magnetic particle inspection method. To do so, several test and operational parameters will be evaluated. The final goal is to achieve a working surface inspection procedure that can be used through coatings.

43146 (EPRI-NP—5490-SR, pp 23.1-23.8) **Infrared boiler inspection system.** Bobo, S.N. (Nondestructive Engineering Corp., Cohasset, MA (USA)). Jun 1988. Research Reports Center, Box 50490, Palo Alto, CA 94303. Order Number TI88012214/JAW.

In Nondestructive Evaluation Program: Progress in 1987.

Infrared has long been utilized to identify heating in power lines and switchgear and was early proposed for inspection of tubing in boilers. However, only recently have procedures been developed that permit rapid economical inspection of furnace waterwalls. Infrared, with its ability to observe large areas without contact, is an attractive method for identifying regions of anomalous tube conditions such as thinning, blockage, and scale. The procedure permits scanning the entire waterwall in a very short period of time without damage to the boiler. Since 1984, EPRI has sponsored work to develop methods for the use of infrared to detect thinning and other anomalies on boiler tubes. The purpose of the work was to confirm on a complete boiler, the results of previous experiments that demonstrated the ability of infrared to detect tube thinning on selected boiler tubes. A further purpose was to determine the relative cost-effectiveness of the procedure vis-a-vis competitive methods.

43147 (EPRI-NP—5490-SR, pp 24.1-24.21) **STEELTEST examination of ferritic stainless steel condenser tubes.** Bergander, M.J.; Beaulieu, R.A. (Scientific Technologies, Inc., Madison, CT (USA)). Jun 1988. Research Reports Center, Box 50490, Palo Alto, CA 94303. Order Number TI88012214/JAW.

In Nondestructive Evaluation Program: Progress in 1987.

Early detection of any service-induced deterioration of tubes in condensers, feedwater heaters and other heat exchangers in the power plant is of primary importance. A leak in the condenser could be costly since it can promote damage in boilers, steam generators, turbines, and other components of the steam cycle by permitting untreated water and air to enter the system. In addition, the in-service inspection of heat exchanger tubing can provide useful information regarding the nature and cause of any tube degradation, thereby assisting the operator in taking proper and timely corrective measures. In recent years, special ferritic stainless steels, such as AL29-4C, Sea-Cure, E-Brite, 439, and similar alloys have been introduced as tube materials in condensers, feedwater heaters, moisture separator/reheaters, and other heat exchangers. In addition, carbon steel tubes were widely used in feedwater heaters and heat exchangers. The main problem with the in-service inspection of these ferritic alloys and carbon steel tubes lies in their highly ferromagnetic properties. These properties severely limit the application of the standard eddy current technique. An effort was undertaken to develop a reliable technique for in-service inspection of ferromagnetic tubes. The new method, called the STEELTEST system, combines the measurement of magnetic flux leakage generated around the defects with measurement of total flux in the tube wall. The heart of the inspection system is a special ID probe that magnetizes the tube and generates signals for any tube defect. This new system has demonstrated its very good sensitivity to small defects. The development and field application of STEELTEST are discussed.

43148 (EPRI-NP—5490-SR, pp 26.1-26.3) **EMAT system for sleeve end inspection.** Glass, B. (Babcock & Wilcox, Lynchburg, VA (USA)). Jun 1988. Research Reports Center, Box 50490, Palo Alto, CA 94303. Order Number TI88012214/JAW.

In Nondestructive Evaluation Program: Progress in 1987.

Sleeves are now installed in steam generator tubes in a number of nuclear plants. As plants age and sleeving technology improves, many new sleeves will be installed. Conventional inspection techniques (eddy current and ultrasonics) are not adequate to examine the parent tube above at the weld and behind the upper end of the sleeve. Eddy current techniques (ET) are adversely affected by the large fill-factor variations, material inconsistencies, and edge effects of the sleeve end. Ultrasonic techniques (UT) are limited by the air gaps at or near the weld region and the difficulty of delivering a probe and acoustic couplant to the tube. Preliminary work has demonstrated that EMAT (electromagnetic acoustic transducer) technology has potential for inspecting steam generator tubes. The EMAT technology is not subject to the above ET and UT limitations of the parent tube behind the sleeve region. The purpose of this work is to develop a field-worthy EMAT system for inspecting sleeved steam generator tubes. Further development of the technology may be directed to the U-bends and other areas that are difficult to examine with conventional techniques. The development of the EMAT system is discussed.

43149 (EPRI-NP—5490-SR, pp 27.1-27.4) **Status of steam generator in-service inspection.** Dow, B.L. Jr. (Energy Management Services, Inc., Little Rock, AR (USA)). Jun 1988. Research Reports Center, Box 50490, Palo Alto, CA 94303. Order Number TI88012214/JAW.

In Nondestructive Evaluation Program: Progress in 1987.

In-service inspection (ISI) of nuclear steam generators is performed to meet both safety and reliability requirements. Safety requirements are detailed in federal regulations (10 CFR 50, Regulatory Guides 1.83 and 1.121) and the plant technical specifications. To satisfy the safety criteria, a minimum ISI program is defined and executed. Although reliability requirements are less well defined, they are just as important. Steam generator tube degradation leads to unscheduled outages and lost revenues. The purpose of the ISI program from a reliability standpoint includes avoiding forced outages, early detection of tube degradation, and prediction of damage progression. The main objective of this project is to assess the ability of present eddy current technology to address both the safety and reliability requirements of steam generator in-service inspection. The status of the project is discussed.

43150 (EPRI-NP—5490-SR, pp 28.1-28.5) **Steam generator tube plugging and tube sleeving criteria.** Thomas, J.M. (Failure Analysis Associates, Palo Alto, CA (USA)). Jun 1988. Research Reports Center, Box 50490, Palo Alto, CA 94303. Order Number TI88012214/JAW.

In Nondestructive Evaluation Program: Progress in 1987.

The objective of this effort is to technically review the current bases for steam generator tube plugging and tube sleeving criteria. The results of this review will be used to establish the analytical and experimental work required to defend or modify existing tube plugging and tube sleeving criteria on a uniform basis. The establishment of a uniform technical basis for tube plugging and tube sleeving criteria is expected to assist utilities petitioning the NRC for changes in the tube plugging and tube sleeving limits contained in their respective technical specifications.

43151 (EPRI-NP—5490-SR, pp 29.1-29.3) **Support for revision of the PWR steam generator inspection guidelines.** Dow, B.L. Jr. (Energy Management Services, Inc., Little Rock, AR (USA)). Jun 1988. Research Reports Center, Box 50490, Palo Alto, CA 94303. Order Number TI88012214/JAW.

In Nondestructive Evaluation Program: Progress in 1987.

Periodic nondestructive examination (NDE) provides valuable information about the condition and expected performance of pressurized water reactor (PWR) steam generators. An effective NDE program detects and monitors the progression of steam generator tube wall degradation and damage precursors. The inspection results are, in turn, used to implement appropriate plant corrective actions that help utilities avoid costly unscheduled outages. NDE inspection technology has been changing rapidly. PWR Steam Generator Inspection Guidelines were written to help utilities assess these changes and to provide recommendations for a comprehensive steam generator inspection program. Guidelines were initially released in September 1983 and revised in July 1985. To incorporate lessons learned and to obtain specific utility endorsement, these guidelines will again be updated in 1987. A select group of utility and vendor NDE experts has been assembled to perform the guidelines update. This update is scheduled for completion by the end of 1987. The guideline revision effort is described.

43152 (EPRI-NP—5490-SR, pp 31.1-31.6) **Turbine erosion measurements by thin layer activation.** Blatchley, C.C. (Spire Corp., Bedford, MA (USA)). Jun 1988. Research Reports Center, Box 50490, Palo Alto, CA 94303. Order Number TI88012214/JAW.

In Nondestructive Evaluation Program: Progress in 1987.

The nature of the solid particle erosion (SPE) process was studied using surface layer and thin layer activation techniques for on-line monitoring of both stationary and rotating turbine components. SPE is caused by iron oxide scale exfoliated as magnetite from the inner surface of boiler tubes and piping, particularly from high-temperature reheaters. Maximum exfoliation of scale occurs during the thermal cycling associated with shut-downs. As a result, SPE is most severe during cold start-ups. However, owing to the lack of an on-line monitoring system, there has previously been no confirmation of these assumptions about the erosion phenomenon. The use of thin layer activation techniques to study turbine erosion is discussed.

43153 (EPRI-NP—5490-SR, pp 32.1-32.2) **Flexible eddy current probe arrays.** Krampfner, Y.; Johnson, D. (Failure Analysis Associates, Palo Alto, CA (USA)). Jun 1988. Research Reports Center, Box 50490, Palo Alto, CA 94303. Order Number TI88012214/JAW.

In Nondestructive Evaluation Program: Progress in 1987.

A new eddy current test (ET) system has been developed. This system is based on utilizing flexible substrate probe arrays to achieve conformance to complex surface geometries and coverage of large test areas without probe scanning. Previous phases of the project resulted in the production of a working prototype. Details

on the prototype development phase will be published in the proceedings of the EPRI Fossil Plant Inspections Workshop, which was held in San Antonio in September 1986. The 1987 effort will be directed at upgrading the prototype and demonstrating the system's potential by performing a practical inspection at a utility site. This inspection will be performed on the blade attachment area of the L-1 row of a fossil steam turbine. The work effort will be divided into two primary activities: the first activity will deal with the upgrading of the prototype to a field-functional level; the second activity will be to conduct an actual inspection at the site of a host utility. These activities are discussed.

43154 (EPRI-NP—5490-SR, pp 33.1-33.3) **Automation of eddy current system for in-service inspection of turbine and generator bores.** Viertl, J.R.M. (General Electric Co., Schenectady, NY (USA)). Jun 1988. Research Reports Center, Box 50490, Palo Alto, CA 94303. Order Number TI88012214/JAW.

In Nondestructive Evaluation Program: Progress in 1987.

The most commonly applied inspection method for ferromagnetic turbine and generator rotor bores is the magnetic particle test technique. This method is subjective, depends on the test operator's skill and diligence in identifying test indications, and suffers from poor repeatability, especially for small indications. Automation would improve repeatability. However, magnetic particle tests are not easily automated, because the data are in the form of sketches, photographs, and written and oral descriptions of the indications. Eddy current inspection has obvious potential to replace magnetic particle methods in this application. Eddy current tests can be readily automated, as the data are in the form of voltages that can be recorded, digitized, and manipulated by a computer. The current project continues the investigation of the correlation between eddy current and magnetic particle inspection. Two systems have been combined to acquire eddy current data automatically. This combination of systems consists of the Nortec-25L Eddyscope (to provide the analog eddy current signals) and the General Electric DATAQ (TM) System (to perform the automatic data acquisition). The automation of the system is discussed.

43155 (EPRI-NP—5490-SR, pp 34.1-34.8) **Remote inspection of steam turbine blades.** Reinhart, E. (Reinhart & Associates, Inc., Austin, TX (USA)). Jun 1988. Research Reports Center, Box 50490, Palo Alto, CA 94303. Order Number TI88012214/JAW.

In Nondestructive Evaluation Program: Progress in 1987.

Turbine blade failures are a major cause of lost generation and expense to the utility industry. In addition, in-service blade failures are a prime cause of unscheduled outages and secondary damage to related components. While some visual inspection can be performed on blade edges and blade attachments with the turbine in place, a comprehensive inspection normally requires complete disassembly and removal of the turbine rotor from its case. Because of the high cost involved in a complete disassembly, and the lack of sensitivity of in-place visual examinations, most blade inspection occurs only during major overhaul outages. There is, therefore, no means of quick, easy inspection of blades with minor disassembly of the turbine during scheduled outages. Experience has demonstrated that methods are available and adaptable to the in-place inspection of certain types of blades and turbine designs. An EPRI-funded program to improve remote inspection equipment, nondestructive examination techniques, industry standards, and procedures for the in-place examinations of L-0 and L-1 turbine blades (and possibly other stages) is currently under way and is described.

43156 (EPRI-NP—5490-SR, pp 36.1-36.17) **Nondestructive evaluation of generator retaining rings.** Nottingham, L.D. (EPRI NDE Center, Charlotte, NC (USA)). Jun 1988. Research Reports Center, Box 50490, Palo Alto, CA 94303. Order Number TI88012214/JAW.

In Nondestructive Evaluation Program: Progress in 1987.

Generator retaining rings are structural rotor components that support the end-turn regions of the rotor windings against centrifugal force. These rings are subjected to very high mechanical stresses; as a result, a significant fraction of all generator rotor structural failures have involved retaining rings. Failure mechanisms have varied, but the one of greatest significance recently has been intergranular stress corrosion cracking (IGSCC). Several years ago, most manufacturers began using special high-strength, nonmagnetic alloys for retaining rings to improve generator electrical performance without sacrificing mechanical strength. Recently, many of the nonmagnetic retaining ring alloys used to date have been found susceptible to IGSCC in the presence of moisture. Methods for nondestructive testing of generator retaining rings are presented.

43157 (EPRI-NP—5490-SR, pp 38.1-38.32) **Piping inspection activities at the EPRI NDE Center.** Ammirato, F.V. (EPRI NDE Center, Charlotte, NC (USA)). Jun 1988. Research Reports Center, Box 50490, Palo Alto, CA 94303. Order Number TI88012214/JAW.

In Nondestructive Evaluation Program: Progress in 1987.

Intergranular stress corrosion cracking (IGSCC) in the primary system of boiling water reactors (BWRs) has been a major reliability issue in recent years. BWR pipe cracking was first reported in 1974 with a low percentage of only small-diameter lines affected. However, with increased plant operating time, the number of reported cracking incidents has risen significantly and in 1982 and 1983 included the large-diameter recirculation lines. With the advent of cracking in large-diameter piping, innovative repair remedies were developed, such as weld overlay for repair (WOR). Although these remedies are effective in extending the service life of piping, they also present challenging NDE problems. The EPRI program for improving piping examination has aimed at systematically resolving the difficulties by optimizing techniques and procedures as well as by developing field-qualified automated examination equipment. The EPRI NDE Center's role has been the evaluation and transfer of the technology necessary to address the current piping examination problems of the nuclear utility industry. These activities normally include the following: technology assessment and improvement; validation through demonstrations and field trials; technology transfer reports, workshops, training, and qualification testing; and acquisition of relevant samples. The activities of the NDE Center are discussed.

43158 (EPRI-NP—5490-SR, pp 39.1-39.16) **Heavy section inspection activities at the EPRI NDE Center.** Willetts, A.J. (EPRI NDE Center, Charlotte, NC (USA)). Jun 1988. Research Reports Center, Box 50490, Palo Alto, CA 94303. Order Number TI88012214/JAW.

In Nondestructive Evaluation Program: Progress in 1987.

Nondestructive evaluation (NDE) of nuclear reactor pressure vessels (RPVs) and other heavy section components poses unique problems because of the size and nature of the materials. The highest level of inspection effectiveness is required to ensure the integrity of these critical components. Some reactor coolant pump parts and certain areas of the RPV are examples of components that can be difficult to examine but require the most sensitive and reliable examinations. EPRI is sponsoring the development of improved heavy section inspection equipment and procedures to address the need for reliable examination. EPRI is also supporting the fabrication of heavy section test samples, containing realistic flaws, to be used in evaluating NDE techniques and procedures. The role of the EPRI NDE Center has been to transfer the EPRI-developed technology to the industry. These activities typically involve the following: technology evaluation and improvement; development and documentation of technical databases on the technology capability; support of utilities in the initial use of new technology; provision of rapid response assistance on utility site-specific applications; and maintenance of a set of representative samples. The activities of the NDE Center are discussed.

43159 (EPRI-NP—5490-SR, pp 40.1-40.19) **Turbine inspection activities at the EPRI NDE Center.** Nottingham, L.D. (EPRI NDE Center, Charlotte, NC (USA)). Jun 1988. Research Reports Center, Box 50490, Palo Alto, CA 94303. Order Number TI88012214/JAW.

In Nondestructive Evaluation Program: Progress in 1987.

High reliability of power generating equipment has been an objective in the electric utility industry for many years. Throughout the power plant, subsystems and components are carefully monitored to ensure they do not reduce the reliability and availability of the overall power system. Catastrophic failures, such as the Gallatin rotor burst in 1974, the shrunk-on disk rupture at Hinkley

Point in 1969, and the generator retaining ring failure at Barsebeck, Sweden, in 1979, have emphasized the failure potential of rotating components and the need for adequate periodic inspection methods. Catastrophic turbine or generator rotor component failures can cause severe financial losses, endanger personnel, and, in nuclear plants, damage safety-related equipment. Consequently, inspection and evaluation of these components have become vital to a comprehensive power plant maintenance program. EPRI has sponsored development of improved inspection and evaluation methods for predicting the remaining life of turbine and generator rotors. The role of this program at the EPRI NDE Center is to evaluate and transfer certain turbine and generator examination and life assessment methods to the utilities. These activities include: evaluation and improvement of examination technology; development and documentation of examination capability databases; improvement, promotion, and maintenance of life assessment codes; and rapid response assistance on utility site-specific problems. The activities of the NDE Center are discussed.

43160 (EPRI-NP—5490-SR, pp 41.1-41.10) **NDE training activities at the EPRI NDE Center.** Pherigo, G.L. (EPRI NDE Center, Charlotte, NC (USA)). Jun 1988. Research Reports Center, Box 50490, Palo Alto, CA 94303. Order Number TI88012214/JAW.

In Nondestructive Evaluation Program: Progress in 1987.

The three principal categories of training activity at the EPRI NDE Center are in-service inspection (ISI) training, technical skills training, and human resource development. The ISI training category, which addresses recently developed NDE technologies that are ready for field application, is divided into two areas. One area provides ongoing training and qualification service to boiling water reactor (BWR) utilities in accordance with the Coordination Plan for NRC/EPRI/BWROG Training and Qualification Activities of NDE Personnel. This plan specifically addresses the detection and sizing of intergranular stress corrosion cracking (IGSCC). The second area includes training activities for other recently developed NDE technologies. Courses in this area include weld overlay examination and advanced eddy current data analysis. The technical skills training is developed and offered to support the basic NDE technology needs of the utilities, with emphasis on utility applications. These programs are provided in direct response to generic or specific needs identified by the utility NDE community. The human resource development activities are focused on long-term utility needs through awareness programs for high schools, technical schools, and universities. These training programs are described.

43161 (EPRI-NP—5490-SR, pp 42.1-42.23) **Steam generator inspection activities at the EPRI NDE Center.** Krzywosz, K. (EPRI NDE Center, Charlotte, NC (USA)). Jun 1988. Research Reports Center, Box 50490, Palo Alto, CA 94303. Order Number TI88012214/JAW.

In Nondestructive Evaluation Program: Progress in 1987.

Various types of corrosion and mechanical damage continue to affect the availability of both recirculating and once-through steam generators. Both the tube bundle and its supporting structure are affected. Intergranular attack and stress corrosion cracking (SCC) are the corrosion-assisted tube-wall damage mechanisms of most concern at this time. Fatigue cracking and fretting at antivibration bars are currently the mechanical damage forms causing most concern. Improved NDE equipment and techniques are providing better detection and characterization of adverse conditions within the steam generators and doing it at an earlier stage. This allows timely corrective action. To maintain the projected life expectancy of existing and new steam generators, remedial measures have been implemented. These measures include shot- or roto-peening, U-bend stress relief, chemical cleaning of secondary side, and sleeving of tubes. The improved NDE technology will also be instrumental in monitoring and assessing the effectiveness of the remedial measures. The revision of guidance documents for steam generator in-service inspection (ISI) is providing more relevant information to support this complex operation. A multitasked project is described that includes evaluation of steam generator tube NDE technology, transfer of this technology to utilities, and rapid response utility assistance.

43162 (EPRI-NP—5557-Vol.1) **ATHOS3 computer code verification: Volume 1, 2/3-scale test: Final report.** Lee, A.Y.; Masiello, P.J. (Westinghouse Electric Corp., Forest Hills, PA (USA). Steam Generator Technology Div.). Jun 1988. 372p. Unlimited audience, publicly available. Research reports Center, Box 50490, Palo Alto, CA 94303;1. Order Number TI88011933/JAW.

As part of an ATHOS3 code verification program as it relates to flow-induced tube vibration prediction, Westinghouse was contracted by the Steam Generator Project Office of EPRI in Project S-310-8, Part I to analyze the flow field in a Westinghouse 2/3 scale test model of the first pass of the preheat section of a Model D4 steam generator. The predicted velocities were to be compared with the test data obtained at midpoints between tube centers at tube Rows 49 (first row of tubes from feedwater entrance), 47, 45, and other locations. The tests were conducted with water at 60 psig and 100{degree}F. The tested water flow rate simulated the feedwater flow rate at full power conditions of a D4 steam generator. Analysis models in both cylindrical and Cartesian coordinates and different flow cell sizes were used in the code predictions. The measured total RMS forces on four front row tubes were also correlated with measured velocities at the four tubes. The results of the code verification with the test data are presented in this report.

43163 (INIS-mf—11044, pp 121-124) **Laboratory for check reactor components and accessories at the Instituto Nacional de Investigaciones Nucleares.** Guzman Ruiz, G. (Instituto Nacional de Investigaciones Nucleares, Mexico City). 1985. (In Spanish). NTIS (US Sales Only), PC A07/MF A01. Order Number DE88780072/JAW. (CONF-8508261—).

From Seminar of the Division of Materials and Testing; Salazar, Mexico (23 Aug 1985).

Short communication.

43164 (INIS-mf—11044, pp 125-135) **Qualification of anticorrosive coatings in nuclear vessels.** Perez Flores, C. (Instituto Nacional de Investigaciones Nucleares, Mexico City). 1985. (In Spanish). NTIS (US Sales Only), PC A07/MF A01. Order Number DE88780072/JAW. (CONF-8508261—).

From Seminar of the Division of Materials and Testing; Salazar, Mexico (23 Aug 1985).

Test qualifications of the behavior of anticorrosive coating systems used in nuclear vessels in service and under the accident conditions of radiation decontamination, steam chemical resistance, thermal conductivity, weathering accelerated aging are presented and discussed.

43165 (INIS-mf—11044, pp 27-45) **Ultrasonic characterization of nuclear reactor pipe materials and welds.** Abrego Lopez, J. (Instituto Nacional de Investigaciones Nucleares, Mexico City). 1985. NTIS (US Sales Only), PC A07/MF A01. Order Number DE88780072/JAW. (CONF-8508261—).

From Seminar of the Division of Materials and Testing; Salazar, Mexico (23 Aug 1985).

From preliminary research on the characterization of cracks in welded pipes from nuclear reactors, we can conclude that it is possible to size cracks by detecting the crack tip and base.

43166 (INIS-mf—11110, pp 8-12) **Basic conceptions for reactor pressure vessel manipulators and their evaluation.** Popp, P. 1987. (In German). NTIS (US Sales Only), PC A03/MF A01. Order Number DE88780071/JAW. (CONF-8704277—).

From 8. scientific conference on power industry of the Ingenieurhochschule Zittau; Zittau, German D.R. (22 Apr 1987).

IHZ Wissenschaftliche Berichte.

The study deals with application fields and basic design conceptions of manipulators in reactor pressure vessels as well as their evaluation. It is shown that manipulators supported at the reactor flange have essential advantages.

43167 (INIS-mf—11111, pp 42-48) **Diagnostic and monitoring systems in nuclear power plants.** Wehling, H.J.; Jax, P.; Streicher, V. (Kraftwerk Union A.G., Erlangen (Germany, F.R.)). 1987. (In German). NTIS (US Sales Only), PC A04/MF A01. Order Number DE88780071/JAW. (CONF-8704277—).

From 8. scientific conference on power industry of the Ingenieurhochschule Zittau; Zittau, German D.R. (22 Apr 1987).

IHZ Wissenschaftliche Berichte.

Monitoring systems are important for the availability of nuclear power plants. A survey is given about such systems designed and constructed by the Kraftwerk Union AG Erlangen (Federal Republic of Germany) in order to assure the mechanical integrity of reactor cooling systems. Three monitoring systems based on microprocessors are presented: KUES (acoustic detection of loose parts), SUES (vibration), and FAMOS (fatigue).

43168 (NUREG/CR—5078-Vol.1) **A reliability program for emergency diesel generators at nuclear power plants: Program structure.** Lofgren, E.V.; DeMoss, G.M.; Fragola, J.R.; Appignani, P.L.; Delarche, G.; Boccio, J. (Nuclear Regulatory Commission, Washington, DC (USA). Div. of Reactor and Plant Systems; Sandia National Labs., Albuquerque, NM (USA)). Apr 1988. 154p. (SAND—87-7176-Vol.1). NTIS, PC A08/MF A01 - GPO. Order Number TI88008512/JAW.

The purpose of this report is to provide technical guidelines for NRC staff use in the development of positions for evaluating emergency diesel generator (EDG) reliability programs. Such reviews will likely result following resolution of USI A-44 and GSI B-56. The diesel generator reliability program is a management system for achieving and maintaining a selected (or target) level of reliability. This can be achieved by: (1) understanding the factors that control the EDG reliability and (2) then applying reliability and maintenance techniques in the proper proportion to achieve selected performance goals. The concepts and guidelines discussed in this report are concepts and approaches that have been successful in applications where high levels of reliability must be maintained. Both an EDG reliability program process and a set of review items for NRC use are provided. The review items represent a checklist for reviewing EDG reliability programs. They do not, in themselves, constitute a reliability program. Rather, the review items are those distinctive features of a reliability program that must be present for the program to be effective.

43169 (SRD-R—439) **Guidelines for the design and assessment of concrete structures subjected to impact. 1987 edition.** Barr, P. (UKAEA Safety and Reliability Directorate, Culcheth). Jan 1987. 34p. H.M. Stationery Office, London, price Pound 5.00.

This document presents techniques, which are advisory rather than mandatory, for designing and assessing the impact behaviour of concrete structures. These recommended techniques are based on extensive studies carried out by UKAEA, CEGB and NNC and on work in France, Germany and the USA. Studies of the impact behaviour of concrete are continuing, and a revised version of this document will be reissued early each year to include the most up to date information.

2203 Fuel Elements

REFER ALSO TO CITATION(S) 42735

43170 (INIS-mf—11210, pp II23-II25) **Irradiation behavior of advanced fuel elements for the high temperature reactor under normal and accident conditions.** Pott, G.; Nabielek, H.; Nickel, H.; Schenk, W. (Kernforschungsanlage Juelich G.m.b.H. (Germany, F.R.)). Dec 1987. NTIS (US Sales Only), PC A13/MF A01. Order Number DE88780087/JAW. (CONF-871287—).

From Nuclear Societies of Israel annual meeting; Haifa, Israel (21 Dec 1987).

Transactions.; V. 14.

43171 (KFKI—1987-59/G) **Method for determining the outlet temperature of fuel assemblies unsupplied with thermometer in WWER-440 reactors.** Miko, S.; Kalya, Z.; Hamvas, I. (Hungarian Academy of Sciences, Budapest. Central Research Inst. for Physics). Sep 1987. 11p. (In Hungarian). NTIS (US Sales Only), PC A03/MF A01. Order Number DE88701768/JAW.

The paper outlines a method for the evaluation of the outlet temperatures of fuel assemblies unsupplied with thermometer in WWER-440 reactors. The process is based on interpolation of directly measured assembly temperatures. A quantitative comparison of the errors of described algorithm to those of standard plant-computer interpolation rutine is also presented.

2204 Control Systems

REFER ALSO TO CITATION(S) 43167

43172 (DOE/NE/37959—16) **Signal validation in nuclear power plants: Progress report No. 6.** Upadhayaya, B.R.; Kerlin, T.W. (Tennessee Univ., Knoxville (USA). Dept. of Nuclear Engineering). 24 Jun 1988. Contract AC02-86NE37959. 11p. NTIS, PC A03/MF A01; 1; GPO Dep. Order Number DE88013076/JAW.

This report summarizes the progress in the Signal Validation Project for the period April-June, 1988. The Annual Progress Report was submitted to the US Department of Energy in May, 1988. On April 27, 1988, Combustion Engineering, Inc. in Windsor, Connecticut, was visited and topics related to the Signal Validation Project were discussed. Northeast Utilities was visited on April 28, 1988, and arrangements were made to acquire more plant operational data (PWR steady-state data). A written request was made to EBR-II to transfer a large plant data base. Two more modules have been added to the signal validation system architecture. These are generalized consistency checking for multiple signals (GCCM), and the hypercube memory structure (HMS) for data representation and diagnostics. The single variable consistency checking has been included as part of the system executive, and is currently functional on the Micro VAX-II workstation.

43173 (DOE/NE/37959—17) **Development of an expert system for signal validation: Topical report.** Qualls, A.L.; Uhrig, R.E.; Upadhyaya, B.R. (Tennessee Univ., Knoxville (USA). Dept. of Nuclear Engineering). Jul 1988. Contract AC02-86NE37959. 126p. NTIS, PC A07/MF A01; 1; GPO Dep. Order Number DE88013077/JAW.

A signal validation and sensor information expert system is developed and applied to nuclear power plant subsystems. The expert system interactively provides the user with a list of sensors used to monitor a subsystem of a power plant and answers the user's questions about the characteristics of those sensors. The expert system performs an evaluation of the present output characteristics of an instrument channel. The evaluation is fully automated and is designed to mimic an operator's approach to signal validation. The evaluation is designed to detect three types of possible sensor anomalies: (1) incorrect average output, (2) improper noise level,and (3) incorrect response to a system perturbation. There are two tests used to detect each possible anomalous condition. One test is a comparison of the specified sensor characteristic against the same characteristic of its redundant sensors. The second test is a prediction of the sensor's expected behavior and comparison with its observed behavior. The evaluation was tested using operational data from twelve sensors used to monitor level, pressure, primary and secondary coolant flow rates, and hot and cold leg temperatures of a steam generator in a commercial nuclear power plant. The results of the testing demonstrated successfully that the evaluation detected the three possible anomalies, and was able to handle conflicting information using the comparison among redundant sensors and the system specific test used to detect the anomalies.

43174 (INIS-mf—11210, pp III28-III31) **Isolation of small malfunctions in a nuclear power plant using a Boolean signature algorithm.** Covaliu, Z.; Ben-Haim, Y. (Israel Atomic Energy Commission, Tel Aviv. Licensing Div.; Technion-Israel Inst. of Tech., Haifa. Dept. of Nuclear Engineering). Dec 1987. NTIS (US Sales Only), PC A13/MF A01. Order Number DE88780087/JAW. (CONF-871287—).

From Nuclear Societies of Israel annual meeting; Haifa, Israel (21 Dec 1987).

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43175 **(ZfK—623) Ex-vessel neutron dosimetry at WWER-440.** Mehner, H.E.; Boehmer, B.; Hagemann, U.; Stephan, I.; Meyer, N. (Zentralinstitut fuer Kernforschung, Rossendorf bei Dresden (German Democratic Republic)). Jul 1987. 17p. (In German). NTIS (US Sales Only), PC A03/MF A01. Order Number DE88702627/JAW.

Measurements of neutron flux densities and neutron spectra had been performed at a WWER-440 unit to investigate the neutron exposure of the reactor pressure vessel. The evaluation of the measurement was carried out with a new developed spectrum adjustment code. Because of the broad response region covering the full energy region of radiation damages the reactions /sup 93/ Nb(n,γ) and /sup 93/Nb(n,n') are especially suited for the purpose of reactor dosimetry. The experiments show that the available neutron transport calculations are conservative in comparison to the measurements.

2205 Environmental Aspects

REFER ALSO TO CITATION(S) 43186, 43228, 43232, 43238, 43922

43176 (IAEA-SR—110(bk.), pp 474-509) **Conceptual design and interpretation on the behavior of mina do Cercado's tailings dam.** Sadowski, G.R.; Mello, L.G.F.S. de; Conceicao, A.H. da; Calixto, S.C. 1986. NTIS (US Sales Only), PC A99/MF A01. Order Number DE88702505/JAW. (CONF-861065—).

From Seminar on management options for low and intermediate level wastes in Latin America; Rio de Janeiro, Brazil (13 Oct 1986).

The deposition of solid and liquid wastes generated by the industrial processing of uranium ores at the Mina do Cercado in Pocos de Caldas, in an area adjacent to the Processing Plant, required specific and judicious studies. Such wastes usually required a suitable chemical treatment so as to reduce their respective radioactivity to the limits accepted by the controlling entities and demand for a strict study of the groundwater regim and geotechnical behaviour of the impoundment area. The special attention should be stressed on the seepage through the mass of the dam and its foundation, as well as through the natural borders of the reservoir. Other aspects taking in account the stability and risk analysis against natural hazards like earthquakes, floods, etc. are usually also taken in consideration.

43177 **(INIS-BR—998) Environmental protection.** Martinez, A.S. (Rio de Janeiro Univ. (Brazil). Coordenacao dos Programas de Pos-graduacao de Engenharia). 1987. 29p. (In Portuguese). (CONF-8707179—). NTIS (US Sales Only), PC A03/MF A01. Order Number DE88702582/JAW.

From Latin American course on the socio-economical benefits of nuclear energy; Rio de Janeiro, Brazil (27 Jul 1987).

The question of environment protection related to the use of nuclear energy aiming to power generation, based on the harmonic concept of economic and industrial development, preserving the environment, is discussed. A brief study of environmental impacts for some energy sources, including nuclear energy, to present the systems of a nuclear power plant which aim at environmental protection, is done. (M.C.K.).

43178 **(NAGRA-NTB—87-22) Stripa Project. Annual report 1986.** (Nationale Genossenschaft fuer die Lagerung Radioaktiver Abfaelle (NAGRA), Baden (Switzerland)). Aug 1987. 39p. Nagra, CH-5401 Baden, Switzerland.

The Stripa Project is an international project being performed under the sponsorship of the OECD Nuclear Energy Agency (NEA). The Project concerns research related to the disposal of highly radioactive waste in crystalline rock. The Research and Development Division of the Swedish Nuclear Fuel and Waste Management Company (SKB) has been entrusted with the management of the project, under the direction of representatives from each participating country. The aim of this report is to inform the OECD Nuclear Energy Agency and the participants in the project about the general progress of work during 1986. (author) 24 figs., 2 tabs.

43179 **(NUCLEBRAS-CDTN—540) Environmental control of nuclear installations.** Aun, P.E.; Castro, J.O.N.M. de. (Centro de Desenvolvimento da Tecnologia Nuclear, Belo Horizonte (Brazil)). 1986. 17p. (In Portuguese). NTIS (US Sales Only), PC A03/MF A01. Order Number DE88702613/JAW.

The programs of environment monitoring of nuclear installations in Brazil, are defined and, some programs of Nuclebras, which is responsible nuclear fuel cycle, are presented. (M.C.K.).

43180 **Gaseous radwaste system backfit design for the Surry nuclear station.** Elguindy, H.; Nelson, R.A.; Wiser, S.L. *Transactions of the American Nuclear Society;* 52: 50-52(1986). (CONF-860610—Summs.).

From American Nuclear Society annual meeting; Reno, NV, USA (15 Jun 1986).

The two-unit pressurized water reactor Surry station, which began operation in 1972, included a pressurized tank gaseous radwaste system as part of its original design. This system, however, has had many operational problems; to alleviate these problems a replacement system employing an ambient temperature charcoal delay system has been designed. This design demonstrates the feasibility of installing and starting up a charcoal delay system in an operation nuclear power station while making extensive use of the existing tanks, valves, and piping.

43181 **Chemical decontamination waste processing methods.** Loiselle, V.; Conroy, K.; Gerdingh, R. *Transactions of the American Nuclear Society;* 52: 52-53(1986). (CONF-860610—Summs.).

From American Nuclear Society annual meeting; Reno, NV, USA (15 Jun 1986).

Chemical decontaminations have been performed at various commercial nuclear plants in the past few years. The treatment of wastes from these projects is usually done with mobile processing systems. This paper presents the criteria used for the design of waste processing equipment as well as additional considerations due to the nature of the decontamination solutions. In addition to the equipment used, several process chemistry problems need to be considered. While equipment may be built that can be used for any project, the chemistry problems are unique to each solution and project. This paper looks at the application to a specific project, the Electric Power Research Institute's (EPRI) Fuel Decontamination Project to be conducted at the Quad Cities station. The approach to solving the chemistry problems unique to Quad Cities are presented.

43182 **Time-dependent removal efficiency of charcoal beds for multicomponent fission gases.** Kim, H.K.; Lee, K.J. *Transactions of the American Nuclear Society;* 52: 53-55(1986). (CONF-860610—Summs.).

From American Nuclear Society annual meeting; Reno, NV, USA (15 Jun 1986).

The removal efficiency of charcoal beds for removal of fission gases varies with the operation time, operating conditions, and the number of adsorbable components. Since charcoal bed systems in nuclear power plants must deal with multicomponent fission gases rather than a single component, it is more plausible to analyze the multicomponent adsorption phenomena, which may be more applicable to the practical off-gas system. The major concerns of this study are to develop a model for the dynamics of charcoal bed systems with multicomponent fission gases and to analyze the time-dependent removal efficiency of charcoal beds in nuclear power plants.

2206 Research, Test, And Experimental Reactors

REFER ALSO TO CITATION(S) 43101

43183 **(INIS-BR—992) Study on uranium-water multiplicative means of the (RESUCO-Subcritical experimental reactor of uranium with oxygen) subcritical assembly by pulsed neutron technique.** Jesus Barbosa, S. de. (Pernambuco Univ., Recife (Brazil). Dept. de Energia Nuclear). 1987. 22p. (In Portuguese). NTIS (US Sales Only), PC A03/MF A01. Order Number DE88702576/JAW.

The effective multiplication factor and the nuclear parameters associated with the variation of (RESUCO- Subcritical Experimental Reactor of Uranium with Oxygen) Subcritical Assembly Configuration, using pulsed neutron technique are analysed. BF3 detectors were used to detect the variation of thermal neutrons in the system, positioned parallelly to fuel elements, and a proton recoil detector was used for monitoring the neutron generation. (M.C.K.).

43184 (INIS-mf—11210, pp III1-III4) **Utilization of the IRR-1 reactor.** Hirshfeld, H.; Nagler, A. (Israel Atomic Energy Commission, Yavne. Soreq Nuclear Research Center). Dec 1987. NTIS (US Sales Only), PC A13/MF A01. Order Number DE88780087/JAW. (CONF-871287—).

From Nuclear Societies of Israel annual meeting; Haifa, Israel (21 Dec 1987).

Transactions.; V. 14.

43185 (INIS-mf—11210, pp III5-III8) **Evaluation of LOCA in the IRR-1 using the 3D-AIRLOCA code.** Nagler, A.; Hirshfeld, H. (Israel Atomic Energy Commission, Yavne. Soreq Nuclear Research Center). Dec 1987. NTIS (US Sales Only), PC A13/MF A01. Order Number DE88780087/JAW. (CONF-871287—).

From Nuclear Societies of Israel annual meeting; Haifa, Israel (21 Dec 1987).

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2207 Plutonium And Isotope Production Reactors

REFER ALSO TO CITATION(S) 42882

2208 Propulsion Reactors

REFER ALSO TO CITATION(S) 43102, 43103, 43104

2209 Reactor Safety

REFER ALSO TO CITATION(S) 42869, 43071, 43177, 43922

43186 **(CNEN-DR-NT-GAPS—03/87) Consequence analysis and probabilistic safety analysis of Angra-1.** Guimaraes, A.C.F. (Comissao Nacional de Energia Nuclear de Brasil, Rio de Janeiro. Dept. de Reatores). Jul 1987. 105p. (In Portuguese). NTIS (US Sales Only), PC A06/MF A01. Order Number DE88702503/JAW.

A methodology for determining the environmental consequences in the site of nuclear power plants, is presented. The methodology obtains as final result the 'S' site matrix, which represents the probabilities of health damage. Two types of healt damages were analysed: the early fatalities and injury. The damages are calculated from the determination of radiation doses which the population in surrounding of the site could be submitted, in the case of severe accident with the core meltdown. The accidents are defined from an initial event, leading to the failure of reactor containment. The results presented the same magnitude order when they were compared with ones obtained in studies of the Zion Nuclear Power Plant. The Angra-1 was adopted as reference reactor and the CRAC-2 computer code was used. (M.C.K.).

43187 **(CNEN-DR-NT-GAPS—04/87) Severe accident analysis using MARCH 1.0 code.** Guimaraes, A.C.F. (Comissao Nacional de Energia Nuclear de Brasil, Rio de Janeiro. Dept. de Reatores). Sep 1987. 43p. (In Portuguese). NTIS (US Sales Only), PC A03/MF A01. Order Number DE88702504/JAW.

The description and utilization of the MARCH 1.0 computer code, which aim to analyse physical phenomena associated with core meltdown accidents in PWR type reactors, are presented. The primary system is modeled as a single volume which is partitioned into a gas (steam and hydrogen) region and a water region. March predicts blowdown from the primary system in single phase. Based on results of the probabilistic safety analysis for the Zion and Indian Point Nuclear Power Plants, the S/sub 2/HFX sequence accident for Angra-1 reactor is studied. The S/sub 2/HFX sequence means that the loss of coolant accident occurs through small break in primary system with bot total failures of the reactor safety system and containment in yours recirculation modes, leading the core melt and the containment failure due to overpressurization. The obtained results were considered reasonable if compared with the results obtained for the Zion and Indian Point nuclear power plants.

43188 **(CONF-880422—2) Seismic isolation and advanced reactors.** Wu, T.S.; Seidensticker, R.W. (Argonne National Lab., IL (USA)). 1988. Contract W-31109-ENG-38. 14p. NTIS, PC A03/MF A01;1; GPO Dep. Order Number DE88010049/JAW.

From Topical meeting on engineering for nuclear plant operation and maintenance; Myrtle Beach, SC, USA (17 Apr 1988).

In advanced reactors where components inside the reactor vessel are subjected to high thermal environment, thin-walled designs are generally preferred in order to minimize stresses induced by temperature. Thin-walled structures, however, have little inherent resistance to seismic loadings. It is therefore not an easy task to design such components that will resist thermal and seismic loads simultaneously. Recently seismic isolation has increasingly been applied to nuclear as well as non-nuclear structures as an efficient and economic engineering solution to mitigate seismic hazards. With seismic isolation, safety margins of both the isolated structure and its contents are enhanced. This paper presents the isolated and unisolated responses of two liquid metal reactor plants to earthquake time-histories. Different isolation systems have been considered in this investigation.

43189 **(CONF-880422—3) Core restraint design for inherent safety.** Moran, T.J. (Argonne National Lab., IL (USA)). 1988. Contract W-31-109-ENG-38. 9p. NTIS, PC A 02; 3; GPO Dep. Order Number DE88011988/JAW.

From Topical meeting on engineering for nuclear plant operation and maintenance; Myrtle Beach, SC, USA (17 Apr 1988).

A simple analytical model is developed of core radial expansion for a fast reactor using a limited-free-bow core restraint design. Essentially elementary beam theory is used to calculate the elastic bow of a driver assembly at the core periphery subject to temperature dependent boundary conditions at the nozzle support, ACLP and TLP and subject to thermal and inelastic bowing deformations. The model is used to show the relative importance of grid plate temperature, core temperature rise, and restraint ring temperature in the inherent response of a limited-free-bow core restraint system to thermal transients. It is also used to explore this inherent core expansion. Limited verification of the model using detailed 3-D core restraint calculations is presented.

43190 **(CONF-880506—2) Modular High-Temperature Gas-Cooled Reactor short term thermal response to flow and reactivity transients.** Cleveland, J.C. (Oak Ridge National Lab., TN (USA)). 1988. Contract AC05-84OR21400. 23p. NTIS, PC A03/MF A01;1; GPO Dep. Order Number DE88008387/JAW.

From Safety of next generation power reactors; Seattle, WA, USA (1 May 1988).

The analyses reported here have been conducted at the Oak Ridge National Laboratory (ORNL) for the US Nuclear Regulatory Commission's (NRC's) Division of Regulatory Applications of the Office of Nuclear Regulatory Research. The short-term thermal

response of the Modular High-Temperature Gas-Cooled Reactor (MHTGR) is analyzed for a range of flow and reactivity transients. These include loss of forced circulation (LOFC) without scram, moisture ingress, spurious withdrawal of a control rod group, hypothetical large and rapid positive reactivity insertion, and a rapid core cooling event. The coupled heat transfer-neutron kinetics model is also described.

43191 **(CONF-880506—20) Breakup and quench of molten metal fuel in sodium.** Gabor, J.D.; Purviance, R.T.; Aeschlimann, R.W.; Spencer, B.W. (Argonne National Lab., IL (USA)). 1988. Contract W-31-109-ENG-38. 7p. NTIS, PC A 02; 3; GPO Dep. Order Number DE88011970/JAW.

From Safety of next generation power reactors; Seattle, WA, USA (1 May 1988).

Tests have been conducted in which the breakup behavior of kilogram quantities of molten uranium, uranium-zirconium alloy, and uranium-iron alloy pour streams in 600C sodium was studied. A sodium depth of less than 0.3 m was required for hydrodynamic breakup and freezing of 25-mm pour streams of uranium and uranium-zirconium alloy with up to 400C melt superheat. The breakup material was primarily in the form of filaments and sheets with a settled bed voidage on the order of 0.9. The uranium-iron alloy with 800C melt superheat exhibited similar behavior except a sodium depth somewhat greater than 0.3 m was required for breakup and freezing of the particles.

43192 **(CONF-880724—22) Characterization of flow regimes in the post-dryout region.** Obot, N.T.; Ishii, M. (Clarkson Univ., Potsdam, NY (USA). Dept. of Chemical Engineering; Argonne National Lab., IL (USA)). 1988. Contract W-31-109-ENG-38. 9p. NTIS, PC A 02; 3; GPO Dep. Order Number DE88012065/JAW.

From 25. American Society of Mechanical Engineers/American Institute of Chemical Engineers/American Nuclear Society national heat transfer conference; Houston, TX, USA (24 Jul 1988).

A visual study of film boiling using photographic and high speed motion-picture methods was carried out to determine the flow regime transition criteria in the post-CHF region. An idealized inverted annular flow was obtained by introducing a liquid jet of Freon 113 through a nozzle, precisely centered with respect to the internal diameter of the test section, with an annual gas flow. The respective ranges for liquid and gas exit velocities were 0.05-0.5 and 0.03-8.2 m/s. Nitrogen and helium were used in the study.

43193 **(EPRI-NP—5721-CCM) HICCUP: A computer code for hydrogen injection, combustion, and cooldown using phenomenological models: Computer code manual, April 1988.** Ural, E.A.; Zalosh, R.G. (Electric Power Research Inst., Palo Alto, CA (USA). Nuclear Power Div.). Apr 1988. 110p. Research Reports Center, Box 50490, Palo Alto, CA 94303;3. Order Number TI88920269/JAW.

HICCUP, the computer code described in this report, models single or multiple non-adiabatic burns of lean hydrogen-air-steam mixtures in a closed vessel. Buoyant axisymmetric flame propagation patterns are assumed and empirical turbulent burning velocity correlations are used to calculate burning rates. Flame quenching and post-combustion cooldown are also modeled. The code uses simple phenomenological models and accounts for the optional effects of continuous hydrogen and steam injection, water sprays, fan-stirred gases, and equipment or other structures in the vessel. HICCUP calculated pressure transients have been compared to data obtained in six different facilities with vessel volumes spanning a range of four orders-of-magnitude. In two moderate-size facilities with spherical vessels, the code accurately reproduces the pressure data without any adjustments to empirical parameters used in the code. In the other facilities with more complicated geometries and large-scale equipment/instrument obstructions, a turbulent burning velocity correlation coefficient in the range 1-3.5 had to be employed to match the data.

43194 **(EPRI-NP—5739) Validation of soil-structure interaction models using in-plant test data from Japan: Final report.** Tseng, W.S.; Takayanagi, T. (Bechtel Group, Inc., San Francisco, CA (USA)). Mar 1988. 185p. Research Reports Center, Box 50490, Palo Alto, CA 94303. Order Number TI88920265/JAW.

Data from the in-plant forced-vibration test conducted on the reactor building of the Tokai-2 (1100 MW, BWR) nuclear power plant in Japan were used for correlation with the results simulation analyses to evaluate the validity of the lumped parameter soil-structure interaction (SSI) models commonly adopted in the US nuclear industry for seismic analyses. The lumped parameter SSI models evaluated consist of lumped mass stick models for the reactor building structure and lumped parameter foundation models represented by either frequency dependent or frequency independent foundation impedances including the effect of embedment. Seismic response analyses were also performed for the Tokai-2 reactor building to evaluate the conservatism of the Japanese seismic design practice for nuclear power plants. The results of seismic analyses using the SSI models correlated with the forced-vibration test results showed that the design basis seismic response based on the Japanese design practice adopted at the time the Tokai-2 plant was designed (assuming a very low radiation damping of 5%) is extremely conservative, since the actual foundation radiation damping based on the forced-vibration test results is in the neighborhood of 15%.

43195 **(EPRI-NP—5813) Auxiliary feedwater spreading and countercurrent flow flooding in a model once-through steam generator: Final report.** Munis, A.; Wassel, A.T.; Ghiaasiaan, S.M.; Mertol, A.; Hashemi, A. (Electric Power Research Inst., Palo Alto, CA (USA); Science Applications International Corp., Hermosa Beach, CA (USA)). Apr 1988. 209p. Unlimited audience, publicly available. Research Reports Center, Box 50490, Palo Alto, CA 94303. Order Number TI88012213/JAW.

Experiments were performed in a separate effects test facility to investigate auxiliary feedwater spreading and counter-current flow flooding in a once-through steam generator model. The test objectives were to investigate: (1) flooding at the tube support plate, (2) spreading of the auxiliary feedwater across the tubes, (3) tube wetting characteristics, and (4) droplet entrainment in the exit steam flow. Eighty tests were performed in three phases involving air-water and steam-water experiments. The tests covered a wide range of auxiliary feedwater flow, air/steam flow, primary side water temperature, and flow rate. A scaling analysis was performed, based on a falling film mathematical model, which guided the selection of test conditions and subsequent data analysis. Experimental measurements and visual observations showed that: (1) entrainment was negligible, (2) spreading of the auxiliary feedwater and tube wetting depend mainly on the auxiliary feedwater injection rate, and (3) evaporation at the tube support plate controls flooding. The analysis showed, and the experiments confirmed, that there are two scaling parameters which control counter-current flow flooding in the passages of the tube support plate. A flooding regime map was constructed which showed the boundaries of the no-flooding and flooding regions as a function of these two scaling parameters.

43196 **(EUR—11296) Separation by transportation in vapor phase of stainless steels components.** Allibert, M.; Gibon, G.; Kurka, G.; Tanis, G. (Commission of the European Communities, Luxembourg). 1987. 31p. (In French). NTIS (US Sales Only), PC A03/MF A01. Order Number DE88753959/JAW.

A procedure for separating cobalt from other constituents of radioactive stainless steel is proposed in order to condition material originating from dismantling of reactor pressure vessels. The procedure is based on the transport in the vapour phase, under the presence of an appropriate carrier gas and a thermal gradient in a sealed device. By calculation, iodine was found to be the most appropriate carrier gas. Tests carried out at 50 mg to 2 g scale in quartz ampoules permitted to determine parameters, i.e. temperature range and gradient, pressure, and the effectiveness. It was shown that steel turnings may be treated efficiently. The procedure

achieves well a partition of stainless steel into two metal masses: one containing the bulk of cobalt and radioactivity, the other depleted of cobalt and suitable for recycling. There is few or no secondary waste created, but the costs of the procedure are estimated to be high, i.e. between 100 and 1,000 ECU/kg.

43197 (INIS-mf—11119) **Documents, used for drawing up the CCRX-report 'Radioactive contamination in the Netherlands caused by the reactor accident at Chernobyl'. Part 1.** (International Atomic Energy Agency, Vienna (Austria)). Dec 1986. 508p. (In English and Dutch). NTIS (US Sales Only), PC A22/MF A01. Order Number DE88701754/JAW.

In these documents the results are summarized of a large number of measurements and calculations performed by various Dutch organizations in consequence of the nuclear reactor accident at Chernobyl. refs.; figs.; tabs.

43198 (INIS-mf—11119, pp 15) **Transport of radionuclides effused from Chernobyl over Europe. Document 2.** Leeuw, F.A.A.M. de; Aalst, R.M. van; Rheineck Leyssius, H.J. van; Kesseboom, H.; Egmond, N.D. van; Scheele, M.P.; Dop, H. van; Ulden, A.P. van. (Rijksinstituut voor Volksgezondheid en Milieuhygiene, Bilthoven (Netherlands); Koninklijk Nederlands Meteorologisch Inst., De Bilt). Dec 1986. (In Dutch). NTIS (US Sales Only), PC A22/MF A01. Order Number DE88701754/JAW.

Tabs. .

In Documents, used for drawing up the CCRX-report 'Radioactive contamination in the Netherlands caused by the reactor accident at Chernobyl'. Part 1.

Transport of radionuclides effused from Chernobyl over Europe is calculated following an atmospheric diffusion model based on an Eulerian GRID model development by the Dutch National Institute for Environment Hygiene (RIVM). The activity concentrations for I-131 are calculated for the period from 26th April until 6th May 1986 and for a number of European observation stations, and compared with the results of actual measurements. Also the cumulative deposition of I-131 over Europe is calculated. The mapped results are compared with those calculated following the Lagrangian PUFF and MESOS models. 3 refs.; 4 figs.; 1 table.

43199 (INIS-mf—11119, pp 43) **Radioactive contamination of the air in the Netherlands after the reactor accident at Chernobyl. Document 4.** Stoutjesdijk, J.F. (Rijksinstituut voor Volksgezondheid en Milieuhygiene, Bilthoven (Netherlands)). Dec 1986. (In Dutch). NTIS (US Sales Only), PC A22/MF A01. Order Number DE88701754/JAW.

Tabs. .

In Documents, used for drawing up the CCRX-report 'Radioactive contamination in the Netherlands caused by the reactor accident at Chernobyl'. Part 1.

A survey is given of radioactivity-concentration observations of various radionuclides in a number of observation stations in the Netherlands during the period from 30th April until 6th May, following after the Chernobyl accident. 9 refs.; 14 figs.; 18 tabs.

43200 (INIS-mf—11119, pp 27) **Radioactive deposition in the Netherlands caused by the reactor accident at Chernobyl. Document 5.** Vaas, L.H. (Rijksinstituut voor Volksgezondheid en Milieuhygiene, Bilthoven (Netherlands)). Dec 1986. (In Dutch). NTIS (US Sales Only), PC A22/MF A01. Order Number DE88701754/JAW.

Tabs. .

In Documents, used for drawing up the CCRX-report 'Radioactive contamination in the Netherlands caused by the reactor accident at Chernobyl'. Part 1.

Concentrations of radionuclides in rainwater in May 1986 are measured with gamma spectroscopy by various institutes in the Netherlands. From the measured values the 'wet' and 'dry' depositions of various radionuclides were estimated. In this report the starting points and methods for these estimations are discussed and the resulting values presented. 9 refs.; 5 figs.; 10 tabs.

43201 (INIS-mf—11119, pp 23) **Surface water, air suspension and purgation mud. Document 8.** Veen, R. van; Oirschot, M.C.M. van; Uunk, E.J.B.; Baardwijk, F.A.N. van. (Rijkswaterstaat, Lelystad (Netherlands). Dienst Binnenwateren/RIZA (Rijksinstituut voor de Zuivering van Afvalwater)). Dec 1986. (In Dutch). NTIS (US Sales Only), PC A22/MF A01. Order Number DE88701754/JAW.

Tabs. .

In Documents, used for drawing up the CCRX-report 'Radioactive contamination in the Netherlands caused by the reactor accident at Chernobyl'. Part 1.

The Chernobyl accident has induced an increase of radioactivity levels in the Dutch surface waters in early May 1986, in general followed by a decrease after about 7th and 8th May. The decrease in the concentration in general took place faster than was expected according to radioactive decay alone. This favorable outcome could be ascribed to processes in the surface waters. It is expected that this decrease will continue, however with a continually decreasing rate because longer living radionuclides will remain relatively more, and because the bottom will serve as 'buffer'. Concerning purgation mud, it has been concluded that measures with respect to dispose of purgation mud to agriculture are not under discussion now, but the survey investigation is still continued. One has dropped to investigate the relation with respect to deposition because of the lack of information comparable with remaining beta-concentrations. 13 figs.; 4 tabs.

43202 (INIS-mf—11119, pp 75) **Measures taken as a result of the nuclear reactor accident at Chernobyl. Document 9.** Eshof, A. van den. (Ministerie van Welzijn, Volksgezondheid en Cultuur, Leidchendam (Netherlands)). Dec 1986. (In Dutch). NTIS (US Sales Only), PC A22/MF A01. Order Number DE88701754/JAW.

Tabs. .

In Documents, used for drawing up the CCRX-report 'Radioactive contamination in the Netherlands caused by the reactor accident at Chernobyl'. Part 1.

In this report first the reasons for and the aims of the legal measures are discussed which were taken in the Netherlands and in coordination with the EC when the radioactive follow up of the Chernobyl accident became manifest. Next a detailed schematical survey of all up to now in the Netherlands proclaimed disposals, conclusions and regulations with reference to the Chernobyl accident is given. Copies of these regulations are also presented.

43203 (INIS-mf—11119, pp 50) **Radioactivity in the food chain: report of measurements of radioactivity in the food chain in the Netherlands after the nuclear reactor accident at Chernobyl, 2 May-31 July 1986. Document 10.** Roosje, G.S. (Rijkskwaliteitsinstituut voor Land- en Tuinbouwprodukten (RIKILT), Wageningen (Netherlands)). Dec 1986. (In Dutch). NTIS (US Sales Only), PC A22/MF A01. Order Number DE88701754/JAW.

Tabs. .

In Documents, used for drawing up the CCRX-report 'Radioactive contamination in the Netherlands caused by the reactor accident at Chernobyl'. Part 1.

During May 1986, after the Chernobyl accident, c.a. 30.000 measurements have been performed of I-131 and Cs-137 contamination in the food chain. In this report the radioactivity-concentrations are presented for grass, milk, meat and thyroids, eggs, fish, vegetables, fruits, game, cattlefood and muds. 11 figs.; 30 tabs.

43204 (INIS-mf—11119, pp 12) **Radioactive contamination of drinking water in the Netherlands caused by the reactor accident at Chernobyl. Document 13.** Mattern, F.C.M. (Rijksinstituut voor Volksgezondheid en Milieuhygiene, Bilthoven (Netherlands)). Dec 1986. (In Dutch). NTIS (US Sales Only), PC A22/MF A01. Order Number DE88701754/JAW.

Tabs. .

In Documents, used for drawing up the CCRX-report 'Radioactive contamination in the Netherlands caused by the reactor accident at Chernobyl'. Part 1.

Results are presented and discussed of beta-activity measurements after the Chernobyl accident of specimens from groundwat-

er-pumping stations and from surface-water utilizing waterworks in the Netherlands. 2 refs.; 10 tabs.

43205 (INIS-mf—11119, pp 17) **Results of measurements of internal contamination of persons caused by the Chernobyl accident. Document 15-1.** Ackers, J.G.; Julius, H.W.; Verhoef, C.W.; Aten, J.B.T.; Gerritsen, A.J.M. (Gezondheidsorganisatie TNO, Arnhem (Netherlands). Radiologische Dienst; Cohen (J.A.) Inst. voor Radiopathologie en Stralenbescherming, Leiden (Netherlands)). Dec 1986. (In Dutch). NTIS (US Sales Only), PC A22/MF A01. Order Number DE88701754/JAW.

Tabs. .

In Documents, used for drawing up the CCRX-report 'Radioactive contamination in the Netherlands caused by the reactor accident at Chernobyl'. Part 1.

A preliminary summary is presented of c.a. 140 measurements of internal radioactive contamination, motivated by the Chernobyl accident, in Dutch persons, by the Radiological Service TNO, Arnhem and the Institute for Radiopathology and Radiation Protection, Leiden, the Netherlands. 4 figs.; 3 tabs.

43206 (INIS-mf—11119, pp 4) **Measurements of persons at ECN, Petten (Netherlands). Document 15-2.** Keverling Buisman, A.S. (Netherlands Energy Research Foundation, Petten). Dec 1986. (In Dutch). NTIS (US Sales Only), PC A22/MF A01. Order Number DE88701754/JAW.

Tabs. .

In Documents, used for drawing up the CCRX-report 'Radioactive contamination in the Netherlands caused by the reactor accident at Chernobyl'. Part 1.

During the period May/June 1986, half a dozen persons, who spent some time in East Europe, were examined for radioactivity. The internal contamination was determined with the total-body counter of the Dutch Center for Energy Research (ECN). Also an examination of 24 Dutch volunteers was started c.a. about half-way through May to determine the course of the internal contamination. The results of the measurements are presented and discussed in this report. 3 refs.; 2 figs.

43207 (INIS-mf—11119, pp 11) **Investigation for the radiation burden with I-131 and Cs-137 of persons who stayed in the USSR and Poland during the nuclear reactor accident at Chernobyl. Document 15-3.** Savelkoul, T.J.F.; Mattern, F.C.M.; Leenhouts, H.P.; Sangster, B.; Oldenburg, S.J. (Rijksinstituut voor Volksgezondheid en Milieuhygiene, Bilthoven (Netherlands); Rijksuniversiteit Utrecht (Netherlands). Academisch Ziekenhuis). Dec 1986. (In Dutch). NTIS (US Sales Only), PC A22/MF A01. Order Number DE88701754/JAW.

Tabs. .

In Documents, used for drawing up the CCRX-report 'Radioactive contamination in the Netherlands caused by the reactor accident at Chernobyl'. Part 1.

At May 1st 23 persons, who had traveled in the Soviet Union at the time of the reactor accident in Chernobyl, were examined for contamination with I-131 and Cs-137. After an initial screening of urine samples for the presence of these radionuclides above background in a gamma-exchanger, the urine of one person was analyzed further with a Ge-Li detector. In this analysis a radioactivity concentration of I-131 was measured of 34Bq/g creatinine and of 2Bq/g creatinine of Cs-137. The effective dose-equivalences calculated from these quantities were at most respectively 270 μSv and 2.6 μSv. At these values no harmful effects on health are expected individually. Besides this examination on contamination with radionuclides everyone was examined medically and had the opportunity to get their questions answered. 8 refs.

43208 (INIS-mf—11119, pp 45) **Estimation of the radiation dose in the Netherlands caused by the Chernobyl accident. Document 17.** Leenhouts, H.P.; Koester, H.W.; Stoutjesdijk, J.F. (Rijksinstituut voor Volksgezondheid en Milieuhygiene, Bilthoven (Netherlands)). Dec 1986. (In Dutch). NTIS (US Sales Only), PC A22/MF A01. Order Number DE88701754/JAW.

Tabs. .

In Documents, used for drawing up the CCRX-report 'Radioactive contamination in the Netherlands caused by the reactor accident at Chernobyl'. Part 1.

The radiation doses for the Dutch population caused by the Chernobyl accident are estimated. The total radiation doses are distinguished in external doses, received from the air and ground, and internal doses, received by inhalation and ingestion. The effective dose-equivalents from external radiation are calculated from (averaged) measurements of radioactivity concentrations in the air and on the ground. For the calculation of effective radiation dose-equivalences from inhalation and ingestion three age categories are distinguished: adults, 10-year and 1-year old childs, according to inhalation rate and food parcels. The calculations of effective radiation dose-equivalences received in the period May/June 1986 are based only on measured contaminations of food. For latter periods also uptake of radionuclides from the soil into the plants and further into the food chain are taken into account. 16 refs.; 26 tabs.

43209 (INIS-mf—11119, pp 19) **Estimation of the radiation burden during stay abroad. Document 18.** Blaauboer, R.O. (Rijksinstituut voor Volksgezondheid en Milieuhygiene, Bilthoven (Netherlands)). Dec 1986. (In Dutch). NTIS (US Sales Only), PC A22/MF A01. Order Number DE88701754/JAW.

Tabs. .

In Documents, used for drawing up the CCRX-report 'Radioactive contamination in the Netherlands caused by the reactor accident at Chernobyl'. Part 1.

A survey is given of deposition of I-131 and Cs-137 in various countries in Europe measured after the Chernobyl reactor accident. Also calculated effective dose equivalences for some critical groups in these countries are presented. 9 refs.; 11 figs.; 1 table.

43210 (INIS-mf—11119, pp 70) **Measurement of radioactive contamination of grass and milk (and a number of other articles of food) otherwise than by the Dutch Department of Agriculture and Fishery and the Dutch National Food Inspection Service. Document 12.** Ruig, W.G. de. (Rijkskwaliteitsinstituut voor Land- en Tuinbouwprodukten (RIKILT), Wageningen (Netherlands)). Dec 1986. (In Dutch). NTIS (US Sales Only), PC A22/MF A01. Order Number DE88701754/JAW.

Tabs. .

In Documents, used for drawing up the CCRX-report 'Radioactive contamination in the Netherlands caused by the reactor accident at Chernobyl'. Part 1.

In this document the measurements are presented of radioactive contamination in the Netherlands in grass, agriculture, market-garden and fishery produce, which were performed after the Chernobyl accident by various Dutch organizations. 9 refs.; 14 figs.; 37 tabs.

43211 (INIS-mf—11120) **Documents used for drawing up the CCRX-report 'Radioactive contamination in the Netherlands caused by the reactor accident at Chernobyl'. Part 2.** (International Atomic Energy Agency, Vienna (Austria)). Jun 1987. 46p. (In Dutch). NTIS (US Sales Only), PC A03/MF A01. Order Number DE88701755/JAW.

In these documents the results are summarized of a large number of measurements and calculations performed by various Dutch organizations in consequence of the nuclear reactor accident at Chernobyl. refs.; figs.; tabs.

43212 (INIS-mf—11120, pp 13) **Meteorological circumstances during the 'Chernobyl-period'. Document 3.** Ivens, R.; Lablans, W.N.; Wessels, H.R.A. (Koninklijk Nederlands Meteorologisch Inst., De Bilt). Jun 1987. (In Dutch). NTIS (US Sales Only), PC A03/MF A01. Order Number DE88701755/JAW.

Tabs. .

In Documents used for drawing up the CCRX-report 'Radioactive contamination in the Netherlands caused by the reactor accident at Chernobyl'. Part 2.

The progress of the meteorological circumstances and air flows in Europe from 26th April up to 8th May 1986, which caused the spread of contaminated air originating from Chernobyl is out-

lined and mapped out. Furthermore a global survey is presented of the precipitation in the Netherlands during the period 2nd May to 10th May based on observations of various observation stations of the Royal Dutch Meteorologic Institute (KNMI). 11 figs.; 1 table (H.W.). refs.

43213 (INIS-mf—11120, pp 14) **Radioactive contamination of the Dutch soil in consequence of the nuclear reactor accident at Chernobyl. Document 6.** Koester, H.W.; Mattern, F.C.M.; Pennders, R.M.J. (Rijksinstituut voor Volksgezondheid en Milieuhygiene, Bilthoven (Netherlands)). Jun 1987. (In Dutch). NTIS (US Sales Only), PC A03/MF A01. Order Number DE88701755/JAW.

Tabs. .

In Documents used for drawing up the CCRX-report 'Radioactive contamination in the Netherlands caused by the reactor accident at Chernobyl'. Part 2.

As a consequence of the reactor accident in Chernobyl air, contaminated with radioactive materials, spread over the Netherlands. From 2nd May to 6th May, with dry and to a greater extent with wet deposits, important quantities of radionuclides came upon the earth surface. In this period the weather circumstances within the Netherlands differed strongly resulting in distinct variations in deposit. In this document a preliminary picture is given of the contamination of the Dutch bottom on the basis of soil samplings made in the first few months after the accident. No attention is paid to geographic differences in bottom contamination. The contamination of the bottom is expressed in Bqkg dry soil as well as in Bqm^2 soil. 5 refs.; 6 tabs. (H.W.).

43214 (INIS-mf—11120, pp 16) **Supplementary measuring program for assessment of the effects of the Chernobyl accident on the Dutch people. Document 19.** Mattern, F.C.M. (Rijksinstituut voor Volksgezondheid en Milieuhygiene, Bilthoven (Netherlands)). Jun 1987. (In Dutch). NTIS (US Sales Only), PC A03/MF A01. Order Number DE88701755/JAW.

Tabs. .

In Documents used for drawing up the CCRX-report 'Radioactive contamination in the Netherlands caused by the reactor accident at Chernobyl'. Part 2.

In order to determine the effects of the reactor accident in Chernobyl on the Dutch people a supplementary measuring program is necessary which predominantly concerns the long-living radionuclides Sr-90, Cs-134 and Cs-137. In this document this program for the second half of 1986 is outlined. (H.W.).

43215 (INIS-mf—11121) **Radioactive contamination in the Netherlands caused by the nuclear reactor accident at Chernobyl.** (Coordinatie-Commissie voor de Metingen van Radioactiviteit en Xenobiotische Stoffen (CCRX), Rijswijk (Netherlands)). Oct 1986. 139p. (In Dutch). NTIS (US Sales Only), PC A07/MF A01. Order Number DE88701756/JAW.

In this report of the Dutch Coordination Commission for Measurements of Radioactivity and Xenobiotic matters (CCRX) a detailed survey is presented of the spread of radioactive material over Europe as a consequence of the reactor accident in Chernobyl and of measurements of the contamination of the physical environment, food and human people in the Netherlands. The radiation burden for the Dutch people and the effects upon public health are estimated and a measuring program is introduced for monitoring the effects of the reactor accident upon the Dutch people. Finally a number of requirements are discussed on the base of the acquired experiments, to which future watching programs should satisfy. 24 refs.; 32 figs.; 16 tabs.

43216 (INIS-mf—11210, pp III37-III39) **Sensitivity analysis of CRAC-2 results regarding the characteristics of a hypothetical nuclear plant accident.** Rambam, M.; Reznik, L.; Tepper, L. (Israel Electric Corp. Ltd., Haifa (Israel). Dept. of Nuclear Engineering). Dec 1987. NTIS (US Sales Only), PC A13/MF A01. Order Number DE88780087/JAW. (CONF-871287—).

From Nuclear Societies of Israel annual meeting; Haifa, Israel (21 Dec 1987).

Transactions.; V. 14.

43217 (INIS-mf—11210, pp II4-II6) **Nuclear reactor safety research in Austria.** Sonneck, G. (Oesterreichisches Forschungszentrum Seibersdorf G.m.b.H.). Dec 1987. NTIS (US Sales Only), PC A13/MF A01. Order Number DE88780087/JAW. (CONF-871287—).

From Nuclear Societies of Israel annual meeting; Haifa, Israel (21 Dec 1987).

Transactions.; V. 14.

43218 (INIS-mf—11210, pp III40-III41) **Severe accident scenarios following externally initiated events in a commercial nuclear power plant.** Marouani, D.; Weiman, S.I. (Israel Electric Corp. Ltd., Haifa (Israel). Dept. of Nuclear Project). Dec 1987. NTIS (US Sales Only), PC A13/MF A01. Order Number DE88780087/JAW. (CONF-871287—).

From Nuclear Societies of Israel annual meeting; Haifa, Israel (21 Dec 1987).

Transactions.; V. 14.

43219 (INIS-mf—11210, pp VI1-VI2) **Dynamic character of failure state in damage accumulation process.** Ingman, D.; Reznik, L. (Technion-Israel Inst. of Tech., Haifa. Dept. of Nuclear Engineering; Israel Electric Corp. Ltd., Haifa (Israel). Dept. of Nuclear Engineering). Dec 1987. NTIS (US Sales Only), PC A13/MF A01. Order Number DE88780087/JAW. (CONF-871287—).

From Nuclear Societies of Israel annual meeting; Haifa, Israel (21 Dec 1987).

Transactions.; V. 14.

43220 (INIS-mf—11210, pp II7) **Unsteady thermal-hydraulics of boiling water safety and containment.** Moody, F.J. (General Electric Co., San Jose, CA (USA). Nuclear Energy Div.). Dec 1987. NTIS (US Sales Only), PC A13/MF A01. Order Number DE88780087/JAW. (CONF-871287—).

From Nuclear Societies of Israel annual meeting; Haifa, Israel (21 Dec 1987).

Transactions.; V. 14.

43221 (INIS-mf—11210, pp III42-III44) **PWR loss of feedwater ATWS analysis using the RELAP4/MOD6 code.** Hasan, D.; Kaizerman, S.; Elias, E.; Wacholder, E. (Technion-Israel Inst. of Tech., Haifa. Dept. of Nuclear Engineering). Dec 1987. NTIS (US Sales Only), PC A13/MF A01. Order Number DE88780087/JAW. (CONF-871287—).

From Nuclear Societies of Israel annual meeting; Haifa, Israel (21 Dec 1987).

Transactions.; V. 14.

43222 (INIS-mf—11210, pp III45-III48) **Advancing DSNP to simulate ATWS in PWR.** Saphier, D.; Gal, D. (Israel Atomic Energy Commission, Yavne. Soreq Nuclear Research Center). Dec 1987. NTIS (US Sales Only), PC A13/MF A01. Order Number DE88780087/JAW. (CONF-871287—).

From Nuclear Societies of Israel annual meeting; Haifa, Israel (21 Dec 1987).

Transactions.; V. 14.

43223 (INIS-mf—11210, pp III49-III52) **Loss of offsite power event simulation.** Gal, D.; Saphier, D. (Israel Atomic Energy Commission, Yavne. Soreq Nuclear Research Center). Dec 1987. NTIS (US Sales Only), PC A13/MF A01. Order Number DE88780087/JAW. (CONF-871287—).

From Nuclear Societies of Israel annual meeting; Haifa, Israel (21 Dec 1987).

Transactions.; V. 14.

43224 (INIS-mf—11210, pp II22) **Small modular high temperature gas-cooled reactors (HTGR): a far reaching inherently safe concept.** Kroeger, W. (Kernforschungsanlage Juelich G.m.b.H. (Germany, F.R.). Inst. fuer Nukleare Sicherheitsforschung). Dec 1987. NTIS (US Sales Only), PC A13/MF A01. Order Number DE88780087/JAW. (CONF-871287—).

From Nuclear Societies of Israel annual meeting; Haifa, Israel (21 Dec 1987).
Transactions.; V. 14.

43225 (INIS-mf—11210, pp IV13-IV16) **Nuclear safety implications of water ingress accidents in HTGRs.** Szabo, J.; Greenspan, E.; Ketter, A.; Ron, S. (Israel Atomic Energy Commission, Tel Aviv). Dec 1987. NTIS (US Sales Only), PC A13/MF A01. Order Number DE88780087/JAW. (CONF-871287—).

From Nuclear Societies of Israel annual meeting; Haifa, Israel (21 Dec 1987).
Transactions.; V. 14.

43226 (INIS-mf—11210, pp IV17-IV20) **Loss of coolant accident in a modular HTGR.** Saphier, D.; Gal, D. (Israel Atomic Energy Commission, Yavne. Soreq Nuclear Research Center). Dec 1987. NTIS (US Sales Only), PC A13/MF A01. Order Number DE88780087/JAW. (CONF-871287—).

From Nuclear Societies of Israel annual meeting; Haifa, Israel (21 Dec 1987).
Transactions.; V. 14.

43227 (INIS-mf—11210, pp IV21-IV23) **On the graphite oxidation rate in HTGRs following an air ingress accident.** Ron, S. (Israel Atomic Energy Commission, Tel Aviv). Dec 1987. NTIS (US Sales Only), PC A13/MF A01. Order Number DE88780087/JAW. (CONF-871287—).

From Nuclear Societies of Israel annual meeting; Haifa, Israel (21 Dec 1987).
Transactions.; V. 14.

43228 (INIS-mf—11210, pp IV24-IV27) **On the consequences of fission products plateout and liftoff in HTGRs.** Ron, S.; Greenspan, E. (Israel Atomic Energy Commission, Tel Aviv). Dec 1987. NTIS (US Sales Only), PC A13/MF A01. Order Number DE88780087/JAW. (CONF-871287—).

From Nuclear Societies of Israel annual meeting; Haifa, Israel (21 Dec 1987).
Transactions.; V. 14.

43229 (INIS-mf—11210, pp IV28-IV32) **Analysis of HGTR vulnerability to external missiles.** Ketter, A.; Szabo, J. (Israel Atomic Energy Commission, Tel Aviv). Dec 1987. NTIS (US Sales Only), PC A13/MF A01. Order Number DE88780087/JAW. (CONF-871287—).

From Nuclear Societies of Israel annual meeting; Haifa, Israel (21 Dec 1987).
Transactions.; V. 14.

43230 **(NUREG—0090-Vol.10-No.3) Report to Congress on abnormal occurrences, July-September 1987.** (Nuclear Regulatory Commission, Washington, DC (USA). Office for Analysis and Evaluation of Operational Data). Mar 1988. 44p. NTIS, PC A03/MF A01. Order Number TI88008446/JAW.

Section 208 of the Energy Reorganization Act of 1974 identifies an abnormal occurrence as an unscheduled incident or event which the Nuclear Regulatory Commission determines to be significant from the standpoint of public health or safety and requires a quarterly report of such events to be made to Congress. This report covers the period from July 1 to September 30, 1987. The report states that for this reporting period, there were two abnormal occurrences at the nuclear power plants licensed to operate. The first involved a significant degradation of plant safety at Oyster Creek; and the second involved a steam generator tube rupture at North Anna Unit 1. There were four abnormal occurrences at the other NRC licensees. The first involved a therapeutic medical misadministration; the second involved a failure to report diagnostic medical misadministrations; the third involved the suspension of a well logging company's license; and the fourth involved the suspension of an industrial radiography company's license. There were two abnormal occurrences reported by an Agreement State (New York). The first involved a hospital contamination incident and the second involved therapeutic medical misadministrations. The report also contains information updating some previously reported abnormal occurrences.

43231 **(NUREG—0090-Vol.10-No.4) Report to Congress on abnormal occurrences, October-December 1987.** (Nuclear Regulatory Commission, Washington, DC (USA). Office for Analysis and Evaluation of Operational Data). Mar 1988. 28p. NTIS, PC A03/MF A01 - GPO. Order Number TI88008447/JAW.

Section 208 of the Energy Reorganization Act of 1974 identifies an abnormal occurrence as an unscheduled incident or event which the Nuclear Regulatory Commission determines to be significant from the standpoint of public health or safety and requires a quarterly report of such events to be made to Congress. This report covers the period from October 1 to December 31, 1987. The report states that for this reporting period, these was one abnormal occurrence at the NRC licensees; the item involved the suspension of license of an oil and gas well tracer company for noncompliance with NRC regulatory requirements. There were no abnormal occurrences report by the Agreement States. The report also contains information updating some previously reported abnormal occurrences.

43232 **(NUREG—0713-Vol.7) Occupational radiation exposure at commercial nuclear power reactors and other facilities, 1985: Eighteenth annual report.** Brooks, B.G. (Nuclear Regulatory Commission, Washington, DC (USA). Div. of Regulatory Applications). Apr 1988. 166p. NTIS, PC A08/MF A01 - GPO. Order Number TI88008443/JAW.

This report summarizes the occupational exposure data that are maintained in the US Nuclear Regulatory Commission's Radiation Exposure Information and Reporting System (REIRS). The bulk of the information contained in the report was extracted from the 1985 annual statistical reports submitted by six of the seven categories of NRC licensees subject to the reporting requirements of 10 CFR Section 20.407. Since there are no geologic repositories for high level waste currently licensed, only six categories will be considered in this report. These six categories of licensees also submit personal identification and exposure information for terminating employees pursuant to 210 CFR Section 20.408, and some analysis of this "termination" data is also presented in this report.

43233 **(NUREG—1231-Suppl.1) Safety Evaluation Report related to Babcock and Wilcox Owners Group Plant Reassessment Program.** (Nuclear Regulatory Commission, Washington, DC (USA). Office of Nuclear Reactor Regulation). Mar 1988. 126p. NTIS, PC A07/MF A01 - GPO;1. Order Number TI88008445/JAW.

Supplement 1 to the "Safety Evaluation Report (SER) Related to the Babcock and Wilcox Owners Group (BWOG's) Plant Reassessment Program" has been prepared by the Office of Nuclear Reactor Regulation of the US Nuclear Regulatory Commission (NRC). This supplement contains the NRC staff's evaluation of the BWOG reassessment of the integrated control system/non-nuclear instrumentation system, the emergency feedwater initiation and control system, reactor trip initiating events, several additional open items identified in the SER, and BWOG comments on the SER.

43234 **(NUREG—1296) Thermal overload protection for electric motors on safety-related motor-operated valves: Generic Issue II.E.6.1.** Rothberg, O. (Nuclear Regulatory Commission, Washington, DC (USA). Div. of Engineering). Jun 1988. 45p. NTIS, PC A03/MF A01 - GPO. Order Number TI88012943/JAW.

NRC regulatory positions, as stated in Regulatory Guide 1.106, Revision 1, have been identified by the Office for Analysis and Evaluation of Operational Data (AEOD) as potential contributors to valve motor burnout. AEOD is particularly concerned

about the allowed policy of bypassing thermal overload devices during normal or accident conditions. Regulatory Guide 1.106 favors compromising the function of thermal overload devices in favor of completing the safety-related action of valves. The purpose of this study was to determine if the guidance contained in Regulatory Guide 1.106 is appropriate and, if not, to recommend the necessary changes. This report describes thermal overload devices commonly used to protect safety-related valve operator motors. The regulatory guidelines stated in Regulatory Guide 1.106 along with the limitations of thermal overload protection are discussed. Supplements and alternatives to thermal overload protection are also described. Findings and conclusions of several AEOD reports are discussed. Information obtained from the standard review plan, standard technical specifications, technical specifications from representative plants, and several papers are cited.

43235 **(NUREG—1306) NRC Safety Significance Assessment Team Report on allegations related to the South Texas Project, Units 1 and 2 (Docket Nos. 50-498 and 50-499).** (Nuclear Regulatory Commission, Washington, DC (USA). Office of Nuclear Reactor Regulation). Mar 1988. 149p. NTIS, PC A07/MF A01 - GPO. Order Number TI88900647/JAW.

This report provides the results of a review by the Safety Significance Assessment Team (SSAT) of the Nuclear Regulatory Commission (NRC) of alleged construction irregularities at Houston Lighting and Power Company's South Texas Project (STP), units 1 and 2 (Docket Nos. 50-498, 50-499), located in Matagorda County, Texas. These allegations were provided to the NRC by the Government Accountability Project (GAP) which received them from approximately 35 current and former employees of STO, and covered a wide range of concerns about hardware and quality assurance and control, and issues of management, harassment/intimidation and wrongdoing. Only those concerns that the SSAT, considered to be technically oriented were selected for review on the basis of their possible safety significance; generic implications; specificity to a particular plant component, system or structure; and to provide a multidiscipline overview of the implementation and effectiveness of the STP Quality Assurance Program. The SSAT review of GAP's allegations has identified no substantive safety issue that would warrant delay in the NRC's consideration of a full-power license for STP Unit 1.

43236 **(NUREG/CR—4763) Safety-related equipment survival in hydrogen burns in large dry PWR [pressurized water reactor] containment buildings.** King, D.B.; Nicolette, V.F.; Dandini, V.J.; Spletzer, B.L. (Nuclear Regulatory Commission, Washington, DC (USA). Div. of Engineering). Mar 1988. Contract AC04-76DP00789. 296p. (SAND—86-2280). NTIS, PC A13/MF A01 - GPO;1. Order Number TI88008527/JAW.

Studies of the threat to safety-related equipment posed by hydrogen burns in both large dry atmospheric and subatmospheric PWR containment buildings have been conducted at Sandia National Laboratories. These studies have taken the form of analyses and experiments. Analyses for an atmospheric large dry containmnet used a model of the Three Mile Island containment building. The subatmospheric analyses studied the Surry Nuclear Power Plant. Both analyses used hydrogen source terms as calculated by the March code. The HECTR computer code was used to analyze hydrogen transport and combustion and their effects on heat transfer models of a pressure transmitter. A series of experiments was conducted to study the survivability of both aged and unaged nuclear qualified cable and pressure transmitters in a simulated LOCA and hydrogen burn environment. All test specimens survived the single hydrogen burn test environments. However, in the multiple burn tests, the cable specimens and pressure transmitter did not survive the environments. In conclusion, single hydrogen burns throughout large dry containments do not appear to pose a serious threat to the safety equipment studied in this report. However, a dilemma occurs when considering the effect of igniter-induced multiple burns in large dry containments. Analyses indicate that the absence of igniters (no combustion) can result in potentially detonable mixtures for both the atmospheric and subatmospheric containments. But with the igniter use, both analyses and experiments indicate that the multiple burn environment can pose a threat to safety equipment.

43237 **(NUREG/CR—4999) Estimation of risk reduction from improved PORV [power operated relief values] reliability in PWRs: Final report.** Hsu, C.J.; Perkins, K.; Youngblood, R. (Nuclear Regulatory Commission, Washington, DC (USA). Div. of Reactor Accident Analysis; Brookhaven National Lab., Upton, NY (USA)). Mar 1988. Contract AC02-76CH00016. 81p. (BNL-NUREG—52101). NTIS, PC A05/MF A01 - GPO. Order Number TI88008444/JAW.

An analysis was performed to explore the risk reduction potential of improving the pressurizer Power Operated Relief Values (PORV) and block valve reliability for two representative PWR plants, Indian Point 3, and Oconee 3. Attention was focused upon particular transient scenarios including steam generator tube rupture (SGTR), a stuck-open PORV, cooldown to cold shutdown, and the use of PORV in low-temperature overpressurization (LTOP) protection. The feasibility of using the PORV as a high point vent to supplement the function of Reactor Vessel Head Vent System (RVHVS) was also studied.

43238 **(VROM-DSB—87-25) Model for calculation of concentration and load on behalf of accidents with radioactive materials.** Janssen, L.A.M.; Heugten, W.H.H. van. (Ministerie van Volkshuisvesting, Ruimtelijke Ordening en Milieubeheer, The Hague (Netherlands). Directie Stralenbescherming). Apr 1987. 29p. (In Dutch). (VROM—70285/4-87). NTIS (US Sales Only), PC A03/MF A01. Order Number DE88701777/JAW.

In the project 'Information- and calculation-system for disaster combatment', by order of the Dutch government, a demonstration model has been developed for a diagnosis system for accidents. In this demonstration a model is used to calculate the concentration- and dose-distributions caused by incidental emissions of limited time. This model is described in this report. 4 refs.; 2 figs.; 3 tabs.

43239 **(VROM-DSB—87-27) Description of the information and calculation system for combatment of accidents with hazardous materials.** Scheur, M.J. van de; Stolk, D.J. (Ministerie van Volkshuisvesting, Ruimtelijke Ordening en Milieubeheer, The Hague (Netherlands). Directie Stralenbescherming). Apr 1987. 73p. (In Dutch). (VROM—70283/4-87). NTIS (US Sales Only), PC A04/MF A01. Order Number DE88701779/JAW.

On request of the Netherlands government by TNO a decision support system is developed for the assessment of the off-site consequences of an accident with toxic or radioactive materials. The interactive system supports the emergency planning in two ways. First, the risk to the residents in the surroundings of the accident is quantified in terms of severity and magnitude. Second, a set of countermeasures is evaluated by which an optimum strategy to reduce the impact of the accident can be determined. At this moment the system is in a development stage. It turned out that even the preliminary system provides information to the decision process that is urgently needed. This specifically refers to the introduction of the time aspects and the quantification of the damage. 7 refs.; 8 figs.; 3 tabs.

43240 **(VROM-DSB—87-28) Netherlands contribution to the EC project: Benchmark exercise on dose estimation in a regulatory context.** Stolk, D.J. (Ministerie van Volkshuisvesting, Ruimtelijke Ordening en Milieubeheer, The Hague (Netherlands). Directie Stralenbescherming). Apr 1987. 38p. (VROM—70288/4-87). NTIS (US Sales Only), PC A03/MF A01. Order Number DE88701780/JAW.

Contains summary in Dutch and French.

On request of the Netherlands government FEL-TNO is developing a decision support system with the acronym RAMBOS for the assessment of the off-site consequences of an accident with hazardous materials. This is a user friendly interactive computer program, which uses very sophisticated graphical means. RAMBOS supports the emergency planning organization in two ways. Firstly, the risk to the residents in the surroundings of the accident is quantified in terms of severity and magnitude (number of casualties, etc.). Secondly, the consequences of countermeasures, such as sheltering and evacuation, are predicted. By evaluating sev-

eral countermeasures the user can determine an optimum policy to reduce the impact of the accident. Within the framework of the EC project 'Benchmark exercise on dose estimation in a regulatory context' on request of the Ministry of Housing, Physical Planning and Environment calculations were carried out with the RAMBOS system. This report contains the results of these calculations. 3 refs.; 2 figs.; 10 tabs.

43241 **Accident probabilities of a NERVA derivative reactor for space power applications.** Simonelli, R.B.; Peoples, J.A.; Chi, J.W.H. (Westinghouse Electric Corp., Madison, PA (USA)). pp 45-50 of Space nuclear power systems, 1986: Volume 5. El-Genk, M.S.; Hoover, M.D. (eds.). Malabar, FL; ORBIT Book Company, Inc. (1987). (CONF-860102—).

From 3. symposium on space nuclear power systems; Albuquerque, NM, USA (13 Jan 1986).

This paper presents a preliminary assessment of the accident probabilities of a NERVA Derivative Reactor used for multimegawatt space power applications. The analysis was based on a reactor design capable of passive reentry breakup and fuel dispersal in the upper atmosphere. The worst-case accident inferred was intact reentry and intact impact, followed by ejection of the control rods from the core and either water immersion or core compaction.

43242 **Contamination awareness at the Dresden Nuclear Power Station.** Pagel, D.J.; Rath, W.C. *Transactions of the American Nuclear Society;* **52**: 18-20(1986). (CONF-860610—Summs.).

From American Nuclear Society annual meeting; Reno, NV, USA (15 Jun 1986).

Dresden Nuclear Power Station, which is located ~ 60 miles southwest of Chicago near Morris, Illinois, has been generating electricity since 1960. Owned by Commonwealth Edison, Dresden was the nation's first privately financed nuclear station. On its site are three boiling water reactors (BWRs). Due to the contamination potential inherent with a reactor, a contamination trending program was created at the station. Studies had indicated a rise in contamination events during refueling outages. Further increases were due to specific work projects such as hydrolyzing operations. The investigations suggested that contract personnel also increased the number of events. In 1983, a contamination awareness program was created. The 1984 contamination awareness program was comprised of the following: (1) a statistical review in which trended contamination events were discussed. (2) A demonstration of protective clothing removal by an individual making various mistakes. (3) Scenarios were developed for use in mock work areas. (4) Upper management involvement. Because of the 1984 program, favorable attention has been focused on Dresden from the US Nuclear Regulatory Commission and the Institute of Nuclear Power Operations.

43243 **Decommissioning regulations.** Moore, E. (Pacific Northwest Lab., Richland, WA (USA)). *Transactions of the American Nuclear Society;* **52**: 31(1986). (CONF-860610—Summs.).

From American Nuclear Society annual meeting; Reno, NV, USA (15 Jun 1986).

NRC-licensed facilities, including those owned by DOE and licensed by NRC, will have to meet NRC's decommissioning requirements when they are adopted by NRC (published as proposed regulations in the February 11, 1985, issue of the Federal Register, 50FR5600). DOE facilities not licensed by NRC may be decommissioned under DOE orders. Disposal of both radioactive and hazardous wastes from either type of facility must be carried out in accordance with EPA standards. Transportation of all radioactive and/or hazardous decommissioning wastes is regulated by DOT.

43244 **Guidelines for producing commercial nuclear power plant decommissioning cost estimates.** LaGuardia, T.S. *Transactions of the American Nuclear Society;* **52**: 31-32(1986). (CONF-860610—Summs.).

From American Nuclear Society annual meeting; Reno, NV, USA (15 Jun 1986).

Decommissioning cost estimates have been made for specific commercial nuclear power plants and for reference plants, utilities, the US Nuclear Regulatory Commission (NRC), the US Dept. of Energy, consultants, and others. The different technical, site-specific, and economic assumptions used have made it difficult to interpret these cost estimates during the process of developing rates and rate structures for the recovery of decommissioning expenses. The estimates made to date have not anticipated that form the bases for the variations in cost estimates. The perceived incompatibility among the economic and technical assumptions in these estimates has added to the difficulties regulators have in deciding rates and rate structures for the recovery of decommissioning costs by nuclear utilities. To assist the industry, the National Environmental Studies Project (NESP) of the Atomic Industrial Forum sponsored a study to produce guidelines for developing decommissioning cost estimates. This guideline document was developed by TLG Engineering for NESP under the direction of a task force made up of some of the top experts in the decommissioning field from nuclear utilities, manufacturers, architect/engineering firms, accounting firms, the NRC, the US Federal Energy Regulatory Commission, state regulatory bodies, the National Association of Regulatory Utility Commissioners, and the electric industry research community.

43245 **Decommissioning dose estimates compared to recent industry experience.** Grant, T.J. *Transactions of the American Nuclear Society;* **52**: 32-33(1986). (CONF-860610—Summs.).

From American Nuclear Society annual meeting; Reno, NV, USA (15 Jun 1986).

Several studies commissioned by the US Nuclear Regulatory Commission have presented an overview of the technology, radiation exposure, and costs of decommissioning a large commercial nuclear power plant. These studies have become key reference documents for a variety of regulatory, research, and financial planning groups. Recent industry experience, however, has called into question the occupational dose estimates in these reports. These studies estimate the total occupational exposure as 1223 person-rem for the immediate dismantlement of a pressurized water reactor and 1845 person-rem for a boiling water reactor (BWR). Subsequent to these studies, the removal of steam generators at several operating power plants has resulted in exposures exceeding 2000 person-rem. If the actual exposure for the removal of only one component is almost double the dose estimate for decommissioning the entire plant, then decommissioning doses could be seriously underestimated. A meaningful comparison of the reported exposures must examine in detail the tasks involved to determine the applicability to decommissioning. This paper reports the results of a detailed analysis of the occupational exposure for several large maintenance projects at operating plants. The projects analyzed included the steam generator replacement at Turkey Point 4; the recirculation pipe replacement at Nine Mile Point; the decontamination of primary piping at three BWR plants; and the removal of reactor internals at various plants.

43246 **Intact decommissioning of nuclear power plants: radiological consequences.** Ostrow, S.L.; Oztunali, O.I.; Grant, T.J. *Transactions of the American Nuclear Society;* **52**: 35(1986). (CONF-860610—Summs.).

From American Nuclear Society annual meeting; Reno, NV, USA (15 Jun 1986).

Intact decommissioning is a new alternative method for decommissioning nuclear power plants. It has potential advantages over the much studied mothballing, entombment, and immediate dismantlement options. Ebasco Services, under contract to the National Environmental Studies Project of the Atomic Industrial Forum, investigated the feasibility and radiological consequences of intact decommissioning for reference pressurized water reactor (PWR) and boiling water reactor (BWR) plants. Northeast Utilities' Millstone 1 plant, typical of a number of Mark-I containment designs, was the reference BWR. Its reactor produces 2011 MW(t), for a net power of 660 MW(e). Portland General Electric's Trojan Nuclear Plant was the reference PWR. Its reactor produces 3500 MW(t) for a net power of 1175 MW(e).

43247 **Perception and acceptance of risks associated with nuclear reactors.** Slovic, P. *Transactions of the American Nuclear Society;* **52**: 37-38(1986). (CONF-860610—Summs.).

From American Nuclear Society annual meeting; Reno, NV, USA (15 Jun 1986).

This paper is concerned with public perception and response to the various risks associated with nuclear power. This paper reviews the results, to date, of research on risk perception and acceptance and attempts to show their relevance to problems pertaining to nuclear power generation and nuclear waste management. The author argues that there is need for a serious research effort, aimed at designing risk management processes that lead to trust and mutual respect among opposing parties and aimed at producing effective multi-way communication and constructive problem solving.

43248 **Risk analyses of buried wastes from electricity generation.** Cohen, B.L. (Univ. of Pittsburgh, PA (USA)). *Transactions of the American Nuclear Society;* **52**: 39-40(1986). (CONF-860610—Summs.).

From American Nuclear Society annual meeting; Reno, NV, USA (15 Jun 1986).

Generic risk analyses of buried wastes from electricity generation are readily made by use of geochemical analogs. Calculations are presented for high-level, low-level, and mining wastes from nuclear power and radioactive waste and chemical carcinogens from coal burning.

43249 **TMI-2 final plant assay: instrument options.** Greenborg, J.; Distenfeld, C.H. *Transactions of the American Nuclear Society;* **52**: 82-85(1986). (CONF-860610—Summs.).

From American Nuclear Society annual meeting; Reno, NV, USA (15 Jun 1986).

The Three Mile Island Unit 2 (TMI-2) accident of March 28, 1979, resulted in transport of a limited amount of fuel debris throughout the primary side of the reactor coolant system (RCS) and into several of the ancillary systems (e.g., makeup and purification). An ongoing analytical effort exists to identify and locate all fuel debris throughout the plant. After defueling has been completed, there will be an assay and inventory of any remaining nuclear material. This information will be used to support the reduction of the plant licensing requirements. This paper reports on the study to identify the nuclear material detection system to be used for this assay. The necessary characteristics of this detection system are high sensitivity, portability, freedom from ambiguity, and operation in an ALARA manner. The study considered all available forms of nuclear material assay.

25 ENERGY STORAGE

2506 Thermal

REFER ALSO TO CITATION(S) 43398, 43404

43250 (EPRI-EM—5454-SR, pp 1.1-1.5) **Load management: issues and opportunities.** Rabl, V.A. Oct 1987. Research Reports Center, Box 50490, Palo Alto, CA 94303. Order Number TI88920086/JAW. (CONF-870273—).

From Seminar on commercial cool storage: state of the art; Denver, CO, USA (19 Feb 1987).

Load management activities are undertaken by utilities to alter the load shape so as to achieve a better match between the customers' demands and the utilities' current and planned resources. As such, the needs for customer-side load management technologies are closely tied to the major supply/demand issues facing the utility industry - the needs to improve load factors and defer future capacity additions. The future for cool storage, thermal storage, energy management control technologies, and customer-tailored load control options are briefly discussed.

43251 (EPRI-EM—5454-SR, pp 2.1-2.11) **Chilled water storage goes to college.** Tamblyn, R.T. (Engineering Interface Ltd., York, Ontario (Canada)). Oct 1987. Research Reports Center, Box 50490, Palo Alto, CA 94303. Order Number TI88920086/JAW. (CONF-870273—).

From Seminar on commercial cool storage: state of the art; Denver, CO, USA (19 Feb 1987).

Thermal storage is particularly viable when existing water chilling systems are being extended. One such system extension which occurs from time to time is the expansion of college campus chilled water distribution systems. This article describes the way in which cool storage can best be applied to college campuses. An assumption is made here that the campus already has a central chilled water system. According to the Association of Physical Plant Administrators, APPA, some 250 of their 1200 registered members already have central chilled water systems. There is the further assumption that the proposed new building, which will connect into the existing chilled water loop, will require the addition of supplementary chillers at the central plant. Instead of expanding the central plant, the designer can provide the new building with a chilled water tank located either alongside or underneath the basement of the new building. The storage can then serve the cooling load of the building by day and be regenerated the following night with the existing central chillers, operating on off peak power. The additional requirement of expanding the capacity of the chilled water loop can be quite expensive. At least one City chilled water supply authority, ran out of water under peak load condition and had to rip up city streets again to augment capacity. Storage overcomes this problem since the new building will use central chilled water only when the tank is being regenerated. This will occur at night when the distribution system has ample capacity. In fact, the use of storage may double the cooling load which any distribution system may serve.

43252 (EPRI-EM—5454-SR, pp 3.1-3.9) **Commercial cool storage field performance monitoring results.** Dobyns, J.E.; Novacek, T.R. (Science Applications International Corp., San Diego, CA (USA)). Oct 1987. Research Reports Center, Box 50490, Palo Alto, CA 94303. Order Number TI88920086/JAW. (CONF-870273—).

From Seminar on commercial cool storage: state of the art; Denver, CO, USA (19 Feb 1987).

In order to measure the technical performance and assess the load management potential of cool storage in commercial applications, three systems were instrumented and monitored during the 1986 cooling season. This paper describes the data acquisition and evaluation system utilized, the individual cool storage systems, and a representative sample of the results obtained. The data acquisition and evaluation system utilized was developed by the Electric Power Research Institute (EPRI) specifically for monitoring cool storage systems. It incorporates remote data retrieval from the on-site data logger and automatic reduction and analysis of the data. Data retrieval is performed on a daily basis to facilitate detection of system or instrument failures in a timely manner. The data reduction software which runs on a personal computer, calculates the efficiency of the cool storage system and estimates the energy consumption and peak demand contribution of a conventional air conditioning system. The three cool storage systems monitored use chilled water as the storage medium and differ only in tank design and capacity. One system uses multiple tanks, one uses a single stratified tank and the third uses three tanks with internal diaphragms. The results indicate that cool storage is an effective method for load management, but minor changes at two of the sites would increase the energy savings.

43253 (EPRI-EM—5454-SR, pp 4.1-4.9) **Low temperature air distribution: economics, field evaluation, designs.** Dorgan, C.E.; Elleson, J.S. (Dorgan, McMahon and Associates, Inc., Madison, WI (USA)). Oct 1987. Research Reports Center, Box 50490, Palo Alto, CA 94303. Order Number TI88920086/JAW. (CONF-870273—).

From Seminar on commercial cool storage: state of the art; Denver, CO, USA (19 Feb 1987).

This paper reviews the test procedure and results of three field evaluations of cold air distribution systems used in conjunction with ice storage thermal cooling plants. Two buildings are located in Virginia and one in the Chicago area. A review of initial economic modeling of cold air distribution, along with design parameters are included. All information was gathered and/or developed through a contract with EPRI.

43254 (EPRI-EM—5454-SR, pp 5.1-5.15) **Design of low-cost, leak-proof concrete storage tanks.** Chow, P.Y. (T.Y. Lin International, San Francisco, CA (USA)). Oct 1987. Research Reports Center, Box 50490, Palo Alto, CA 94303. Order Number TI88920086/JAW. (CONF-870273—).

From Seminar on commercial cool storage: state of the art; Denver, CO, USA (19 Feb 1987).

This paper discusses the design process that is aimed at achieving the goal of $0.50 per gallon cost rate for the construction of a low-cost cool concrete tank. Parametric cost study was performed on 12 tanks with storage capacities ranging from 25,000 to 500,000 gallons. These were divided equally for three tank schemes: Scheme A for pressurized, below-ground tanks; Scheme B for unpressurized, above-ground tanks; and Scheme C for unpressurized, below-ground tanks. The results of the study were checked against those from competitive bids on three tank designs with capacities of 35,000, 141,000 and 367,000 gallons respectively. The bids were submitted by 6 invited contractors from California and Midwest areas. Bid results were sufficiently encouraging for a test tank to be constructed at the Construction Technology Laboratories at Skokie, Illinois, and tested in December, 1986 to evaluate its structural integrity, serviceability and thermal efficiency, and the performance of the radial diffuser.

43255 (EPRI-EM—5454-SR, pp 6.1-6.10) **Concrete storage tank construction techniques and quality control.** Anderson, E.D.; Hanson, N.W.; Schultz, D.M. (Construction Technology Labs., Inc., Skokie, IL (USA)). Oct 1987. Research Reports Center, Box 50490, Palo Alto, CA 94303. Order Number TI88920086/JAW. (CONF-870273—).

From Seminar on commercial cool storage: state of the art; Denver, CO, USA (19 Feb 1987).

A test program is being conducted to develop an economical thermal storage system that meets specified performance criteria. This paper describes the construction procedures used for building a thermal storage system that utilizes a cast-in-place post-tensioned concrete tank. The tank is a model approximately half scale having an internal diameter of 20 ft and an internal height of 16 ft. The construction procedures used for the base slab, wall, roof slab, and post-tensioning are described. The construction procedures and sequence described for this model reflect those appropriate for similar tank construction in the field.

43256 (EPRI-EM—5454-SR, pp 7.1-7.15) **Stratified chilled water storage techniques.** Hiller, C. Oct 1987. Research Reports Center, Box 50490, Palo Alto, CA 94303. Order Number TI88920086/JAW. (CONF-870273—).

From Seminar on commercial cool storage: state of the art; Denver, CO, USA (19 Feb 1987).

Chilled water storage is one of several electric load shifting techniques that have become increasingly important in recent years as methods of improving utilization of existing electrical generating capacity. In this approach, chilled water is generated and stored during off-peak (night time) hours, for use in building cooling during peak demand periods. The current paper describes good design and operating principles for thermally stratified chilled water storage systems, where cold supply and warm return water are stored in the same tank, separated only due to density differences.

43257 (EPRI-EM—5454-SR, pp 8.1-8.9) **Water technology in thermal energy storage systems.** Ahlgren, R.M. (Ahlgren Associates, Waukesha, WI (USA)). Oct 1987. Research Reports Center, Box 50490, Palo Alto, CA 94303. Order Number TI88920086/JAW. (CONF-870273—).

From Seminar on commercial cool storage: state of the art; Denver, CO, USA (19 Feb 1987).

Water has many properties which make it an almost ideal medium for storage and transfer of cooling energy. However, even pure water cannot be used in cooling thermal storage systems without careful attention to water chemistry management. There are three water conditions which may cause problems in cooling systems, corrosion, biofouling, and sludge deposits. Corrosion and biological fouling are usually the most common problems but both can be readily controlled by proper chemical addition. Starting a system with good pre-operational cleaning procedures is essential and is probably the best route to long term waterside success and efficiency. A wide variety of reference materials, professional and educational assistance, and water treatment chemical supplier support help is readily available.

43258 (EPRI-EM—5454-SR, pp 10.1-10.11) **Analysis tools for TES evaluation and marketing.** McMenamin, J.S. (Regional Economic Research, Inc., San Diego, CA (USA)). Oct 1987. Research Reports Center, Box 50490, Palo Alto, CA 94303. Order Number TI88920086/JAW. (CONF-870273—).

From Seminar on commercial cool storage: state of the art; Denver, CO, USA (19 Feb 1987).

This paper discusses three EPRI computer tools that can help utility analysts quantify the costs and benefits of thermal energy storage systems. These are (a) COOLAID, which evaluate cost impacts in commercial buildings, (b) COMMEND, which provides a framework and data for segmenting and analyzing the commercial market, and (c) LMSTM, which provides a general integrated planning framework for evaluating the net benefits of demand-side and supply-side planning options.

43259 (EPRI-EM—5454-SR, pp 11.1-11.10) **Optimal controller for cool storage systems operation.** Mathur, A. (Honeywell Inc., Golden Valley, MN (USA)). Oct 1987. Research Reports Center, Box 50490, Palo Alto, CA 94303. Order Number TI88920086/JAW. (CONF-870273—).

From Seminar on commercial cool storage: state of the art; Denver, CO, USA (19 Feb 1987).

Honeywell is designing and developing an optimal supervisory controller for cool storage operation that will minimize the electric utility bill for cooling of commercial and institutional buildings using commonly available cool storage systems, such as chilled water and ice storage. This paper provides a description of the elements of such a controller along with the performance results using simulated loads. A summary description of the load prediction approach is provided, which is an important element of the controller. A very good agreement between the predicted and actual (simulated) loads was achieved. Included are the results of the use of this optimal controller for different storage and chiller design sizes and a comparison of the optimal strategy with the currently used conventional chiller and storage priority control. The controller features and a brief description of the controller are provided.

43260 (EPRI-EM—5454-SR, pp 12.1-12.17) **Investigation into low temperature thermal energy storage technologies.** Geistert, D.L.; Kohlenberger, C.R. (Southern California Edison, Rosemead (USA)). Oct 1987. Research Reports Center, Box 50490, Palo Alto, CA 94303. Order Number TI88920086/JAW. (CONF-870273—).

From Seminar on commercial cool storage: state of the art; Denver, CO, USA (19 Feb 1987).

There are a number of industries (e.g., food, chemical, etc.) that have a requirement for low-temperature - below 32 F - process cooling. This paper investigated the technical and economic viability of thermal storage in the frozen food industry to supply a -40 F load. Three active storage technologies were identified that are commercially available: (1) Stored Carbon Dioxide; (2) brine storage, and (3) High (2nd) Stage Condensing. In addition to these active storage technologies, product storage, using the flywheel effect of a stored product, is shown also to be a concept that can shift a low-temperature cooling load. These technologies were shown to have merit when Southern California Edison's TOU-SOP (Super Off-Peak) rate and a 200 $/kW shifted incentive was applied.

43261 (EPRI-EM—5454-SR, pp 13.1-13.7) **Marketing cool storage technology.** McCannon, L. (McCannon Consulting Group, Inc., San Diego, CA (USA)). Oct 1987. Research Reports Center, Box 50490, Palo Alto, CA 94303. Order Number TI88920086/JAW. (CONF-870273—).

From Seminar on commercial cool storage: state of the art; Denver, CO, USA (19 Feb 1987).

With the general increase in electricity rates, commercial and industrial customers have become strongly motivated to seek methods of achieving reductions in electric bills. At the same time, electric utilities have been faced with rising construction costs, more stringent regulations, and increasing environmental constraints regarding development of new generating facilities. As the viability of cool storage has been substantiated by research conducted by Electric Power Research Institute, and by numerous installations, it

has become acknowledged that cool storage can provide substantial benefits to utilities and end-users alike. A need was recognized for a means to provide for technology transfer and dissemination of current information in the field. The International Thermal Storage Advisory Council was formed to help meet this perceived need. This paper reviews activities of EPRI and ITSAC to achieve widespread acceptance of the technology.

43262 (EPRI-EM—5454-SR, pp 14.1-14.11) **Rooftops: the big challenge for COPAC (commercial off-peak air conditioning).** MacCracken, C.D. (Calmac Manufacturing Corp., Englewood, NJ (USA)). Oct 1987. Research Reports Center, Box 50490, Palo Alto, CA 94303. Order Number TI88920086/JAW. (CONF-870273—).

From Seminar on commercial cool storage: state of the art; Denver, CO, USA (19 Feb 1987).

It's David and Goliath all over again. Two small ice storage manufacturers have entered the huge mass market of packaged (unitary) rooftop air conditioners - with a difference. These are off-peak storage units that avoid peak kW and shift them to night hours. One of them also provides off-peak storage for heat pumping in winter. Light enough weight for roof loading is provided by plastic tanks and freezing solid. Both full and partial storage equipment is involved in the most popular sizes. Both require different kinds of utility rates. Previously, COPAC has been limited to central chiller systems, only 30% of the commercial market. To meet utility goals of broad load shifting, rooftop COPAC is their challenge of the future.

43263 (EPRI-EM—5454-SR, pp 15.1-15.8) **Emerging technologies.** Wendland, R.D. Oct 1987. Research Reports Center, Box 50490, Palo Alto, CA 94303. Order Number TI88920086/JAW. (CONF-870273—).

From Seminar on commercial cool storage: state of the art; Denver, CO, USA (19 Feb 1987).

Substantial progress is being made in improving the performance and reliability of HVAC systems utilizing cool storage, while simultaneously reducing capital costs. It is anticipated this evolutionary process will continue in the future. This paper presents several on-going research and development projects in process which may have an impact.

43264 (EPRI-EM—5454-SR, pp 16.1-16.8) **Design and evaluation of a cool storage program.** Therrien, K.M. (Boston Edison Co., MA). Oct 1987. Research Reports Center, Box 50490, Palo Alto, CA 94303. Order Number TI88920086/JAW. (CONF-870273—).

From Seminar on commercial cool storage: state of the art; Denver, CO, USA (19 Feb 1987).

Boston Edison Company has integrated its supply planning, demand planning and forecasting functions to achieve a net result of least-cost planning. The responsibilities of demand planning include assessing corporate needs, identifying available technologies, designing conservation and load management programs and evaluating them against traditional supply options. This paper describes the entire process using Cool Storage as an example. The major emphasis is on the research involved in the design and evaluation of this program.

43265 (EPRI-EM—5454-SR, pp 17.1-17.7) **Marketing cool storage at Texas Utilities.** Tackett, R.K. (Dallas Power and Light, TX (USA)). Oct 1987. Research Reports Center, Box 50490, Palo Alto, CA 94303. Order Number TI88920086/JAW. (CONF-870273—).

From Seminar on commercial cool storage: state of the art; Denver, CO, USA (19 Feb 1987).

This paper (1) discusses Texas Utilities' attitude towards thermal storage, (2) describes their current marketing activities, and (3) attempts to explain why the thermal storage program has been so successful. The following conclusions have been reached by Texas Utilities as a result of their experience in marketing cool storage. (1) To work, a thermal storage program must provide mutual benefits to both the customer and the utility. (2) To be seriously committed to a program, the utility company must assess a dollar value and a qualitative value to thermal storage. (3) The utility must examine their standing on all policy issues that could affect the customer's risks and the utility's credibility. (4) The utility must maintain contact with their customers, even if a marketing program does not exist.

43266 (EPRI-EM—5454-SR, pp 18.1-18.4) **Promotion of thermal storage without incentives.** Pientka, K.A. (Commonwealth Edison Co., Chicago, IL (USA)). Oct 1987. Research Reports Center, Box 50490, Palo Alto, CA 94303. Order Number TI88920086/JAW. (CONF-870273—).

From Seminar on commercial cool storage: state of the art; Denver, CO, USA (19 Feb 1987).

This paper reviews the experiences that Commonwealth Edison Company (C.E. Co.) has had in promoting cold thermal storage (ice storage) without case incentives. C.E. Co. is the electric utility that serves the northern one-quarter of Illinois, including the metropolitan Chicago area. C.E. Co. is markedly summer peaking and has experienced a declining load factor. In an effort to reverse this negative trend, a wide range of marketing programs have been established, including the promotion of ice storage. Specifically this paper examines the following: factors affecting the decision to promote ice storage, marketing strategy, results, and recommendations.

43267 (EPRI-EM—5454-SR, pp 19.1-19.4) **Operating costs of alternate cooling systems.** Laybourn, D.R. (San Diego Gas & Electric Co., CA (USA)). Oct 1987. Research Reports Center, Box 50490, Palo Alto, CA 94303. Order Number TI88920086/JAW. (CONF-870273—).

From Seminar on commercial cool storage: state of the art; Denver, CO, USA (19 Feb 1987).

Cool storage is recognized as a viable air-conditioning system in San Diego because of time-of-use rates and cash incentives. Of the three cooling options available to builders, it provides the best payback. Penetration is growing in both the new construction and retrofit sectors. The utility takes a very pro-active role in marketing cool storage by providing estimates of utility bill savings, and by acting as the catalyst to introduce customers to equipment suppliers and knowledgeable engineers. A 15-year agreement helps protect the utility's investment in these systems.

2509 Batteries

REFER ALSO TO CITATION(S) 43435, 43480

43268 (CRIE-T—86032) **Loss evaluation of self-commutated power conditioner for battery energy storage system.** Ishikawa, Tadao. (Central Research Inst. of Electric Power Industry, Tokyo (Japan)). Jun 1987. 38p. (In Japanese). NTIS (US Sales Only), PC A03/MF A01. Order Number DE88752075/JAW.

Regarding the loss of the voltage-fed self-commutated type converter supposed to be used for the battery energy storage system of magawatt class, its loss calculation formulas in conformity with the operating conditions of the converter are derived, and the operation control range of the converter taking into consideration the loss is also studied. Namely, as to the loss of the switching elements playing a very important role in the efficiency calculation of the converter, a new calculation method is derived that is capable of evaluating the loss more accurately and also corresponding to the variation of the operating conditions of the battery. This calculation method was applied to the simulator of the battery emerge storage system in which actual machines were used as the models, and it was confirmed that the losses coincide well under whatever operating conditions. Moreover, to minimize the margin of the actual operating control conditions of the converter against such factors as the operating output of the storage system, the I-V characteristics in conformity with the charge and discharge of the battery, and the loss of the converter, the value of the range taking into consideration the loss has been calculated. As a result, it was made possible to judge the active and reactive power characteristics at the charge and discharge cycles. (23 figs, 5 tabs)

43269 (UCRL—53843) Crystallization of aluminum hydroxide in the aluminum-air battery: Literature review, crystallizer design, and results of integrated system tests. Maimoni, A. (Lawrence Livermore National Lab., CA (USA)). 31 Mar 1988. Contract W-7405-ENG-48. 102p. NTIS, PC A06/MF A01;1; GPO Dep. Order Number DE88010510/JAW.

The literature on aluminum trihydroxide crystallization is reviewed and the implications of crystallization on the design and performance of the aluminum-air battery are illustrated. Results of research on hydrargillite crystallization under battery operating conditions at Alcoa Laboratories, Alcan Kingston Laboratories, and Lawrence Livermore National Laboratory are summarized and are applied to the design of an electrolyte management system using lamella settlers for clarification of the electrolyte and product separation. The design principles were validated in a series of experiments that, for the first time in the aluminum-air program, demonstrated continuous operation of an integrated system consisting of cells, crystallizer, and a product-removal system. 42 refs., 88 figs., 2 tabs.

29 ENERGY PLANNING AND POLICY

2901 Energy Analysis And Modeling

REFER ALSO TO CITATION(S) 43405

43270 (ANL/ES—153) Verification of energy's role as a determinant of US economic activity. Santini, D.J. (Argonne National Lab., IL (USA)). Oct 1987. Contract W-31109-ENG-38. 60p. NTIS, PC A04/MF A01; 1; GPO Dep. Order Number DE88012757/JAW.

A series of single-equation dynamic regression models are constructed to test the hypotheses that both "thermodynamic" and economic-efficiency (t-efficiency and e-efficiency, respectively) configurations of lagged energy variables are statistically informative separately and jointly about subsequent changes in real gross national product (GNP) per capita and in unemployment rate. Separately, t-efficiency is based on quantity of energy used per unit of GNP, while e-efficiency is based on real price of tested energy variables. Used jointly, the two measure real energy cost per unit of real GNP. Tested subperiods are within the 1890-1985 period. Macroeconomic activity is found to be much less informative about energy variables that are energy variables about macroeconomic activity. One-way tests are conducted in which the informativeness of major e-efficiency (wholesale price) variables and budget-share variables about subsequent macroeconomic activity are compared to the informativeness of the e-efficiency energy variable and the combined e- and t-efficiencies energy variable respectively. The energy variables are found to represent the only major category of expenditure whose statistical tests for informativeness about subsequent macroeconomic activity result in coefficient signs that consistently imply a statistically significant negative effect on subsequent macroeconomic activity in the full 1890-1985 period. 64 refs., 14 tabs.

43271 (DM—12) An investigation of the relationship between energy and the other production inputs in Canadian manufacturing. (DataMetrics Ltd., Calgary, Alberta (Canada)). Jan 1983. 60p. (CE—01542). CANMET/TID, Energy, Mines and Resources Canada, 555 Booth St., Ottawa, Ont., Canada K1A 0G1; $0.34CAN per page, $3.40 CAN minimum.

This study investigates issues involved in the impact of energy price changes on energy consumption and on other economic inputs used in industry in Canada. Economic models were devised and fitted to historical data to explain how various production inputs combine to produce output, and how they interact. It proved feasible to estimate a complex form of model, predicated on production theory, to these data. The ability of the model to explain variations in inputs relative to output was reasonable. The model discloses important relationships between energy demand and the relative prices of energy prices and other inputs; it implies that explanations of energy consumption trends cannot be divorced from examining price variations in the other inputs. In total manufacturing, labor and capital price changes have only modest effects on energy consumption while the impact of changing prices of materials is large. An important aspect is the underlying relationships between production inputs, particularly whether they are substitutes or complements, i.e., whether a reduction in demand for one input increases or reduces the demand for another. Substitutional relationships between labor and materials, and energy and materials, were found to hold over both short and long term. On an overall basis, capital has not tended to substitute for energy even with higher energy prices. Another aspect disclosed by the model is the nature of technological change, which has tended to use both capital and energy and save labor, with little effect on the use of materials. The ability for the model to explain relations between production inputs and outputs was better for a single industry than for the total manufacturing sector. 9 refs., 18 tabs.

43272 (EMR/TE—TE826) Truck fuel consumption in Canada. Bhattacharyya, S.K. (Department of Energy, Mines and Resources, Ottawa, Ontario (Canada). Transportation Energy Div.). Feb 1982. 84p. (CE—01584). CANMET/TID, Energy, Mines and Resources Canada, 555 Booth St., Ottawa, Ont., Canada K1A 0G1; $0.34CAN per page, $3.40 CAN minimum.

This report presents the results of a preliminary study of truck fuel consumption in Canada. The purpose of the study was to provide a set of readily available data on truck fuel consumption and also various key input data such as provincial registrations of trucks, truck utilization, fuel efficiencies etc. which are essential for the development of a truck fuel consumption model in Canada. Professionals in the transportation and energy area in provincial and federal governments were contacted, a body of relevant data collected, and a literature search conducted. With the available data, two versions of a Canadian Truck Fuel Consumption Model were calibrated based on registration data and a survival curve. The estimates of truck fuel consumption as obtained from the models for the years 1979 and 1980 are 13.99 billion liters and 14.1 billion liters, respectively. On the basis of the evidence available from the Ontario Ministry of Energy, the share of fuel consumption in the trucking subsector at the national level matches with that of the level of the province of Ontario. Finally, the limitations of the model development were highlighted. A detailed step-by-step method of further research which could be undertaken in this area was outlined. It is expected that the model suggested here could serve the purposes of trucking energy monitoring and policy testing after the necessary modifications are made. 51 refs., 35 tabs.

43273 (MU/HEC—G8523) MARKAL-QUEBEC: a report on the model and data base improvements. Haurie, A.; Loulou, R. (Montreal Univ., Quebec (Canada). Ecole des Hautes Etudes Commerciales). Dec 1985. 213p. (CE—01645). CANMET/TID, Energy, Mines and Resources Canada, 555 Booth St., Ottawa, Ont., Canada K1A 0G1; $0.34CAN per page, $0.34 CAN minimum.

MARKAL is a software developed under the sponsorship of the International Energy Agency which can be used in long range forecasting and planning. It produces the following outputs: a capacity expansion program for a comprehensive set of energy supply technologies, an operation program for the technologies with positive capacity, a description of the energy forms used in each sector of the economy, a description of the end-use technologies which seem the most promising in terms of cost-effectiveness, a marginal value for each energy form, and a reduced cost for each activity which indicates the marginal increase of the system cost if this activity were forced into the program. By a judicious use of this input-output relationship induced by MARKAL, a series of "what if" studies can be performed and the possible reactions of the energy system to modifications in the economic and technology environment can be explored. This report gives a general presentation of the Quebec energy system modelling realized through the MARKAL model, and aimed at the implementation of a system analysis methodology for energy policy assessment and long range technology evaluation. The report presents the MARKAL methodology, the model and data base inprovements achieved within this research contract, and indicates the possible uses and future developments of the present model which could lead to a model adapted to the multiregional structure of Canada. A quick presentation of a

run of the model is provided. Two appendices show the level of details of the data base and of the output of a MARKAL run. 22 refs., 17 figs., 8 tabs.

2902 Economics And Sociology

REFER ALSO TO CITATION(S) 42778, 42916, 43270, 43271, 43422, 43971

43274 (DOE/MI/10113—T1) Minority introduction to engineering (MITE). Performance report. (Prairie View A and M Univ., TX (USA). Coll. of Engineering). Sum 1987. Contract FG01-87MI10113. 76p. NTIS, PC A 05; 3; GPO Dep. Order Number DE88012124/JAW.

The purpose of the 1987 MITE report and study was to determine how effective the MITE I and MITE II workshops model, developed at Prairie View A & M University, provided high school students with experiences in mathematics, physics, English, computer science and professional skills. These experiences would raise their level of competence and build a more positive attitude toward pursuing engineering as a career. Therefore, the probability would be increased significantly of these students returning to their respective high schools and studying harder and enrolling in more advanced mathematics and science courses. The teaching methods employed in the model were traditional and individualized instruction where the inductive, deductive, and spiraling techniques were utilized.

43275 (SAND—88-1077) Sandia National Laboratories and higher education in New Mexico: Summary report. (Sandia National Labs., Albuquerque, NM (USA)). May 1988. Contract AC04-76DP00789. 12p. NTIS, PC A02/MF A01;1; GPO Dep. Order Number DE88012112/JAW.

Sandia National Laboratories interacts extensively with colleges and universities in New Mexico. This report summarizes several of these relationships in employee education, research contracts, loaned equipment, temporary employment and other areas. 8 tabs.

43276 (SAND—88-1078) Sandia National Laboratories and higher education in New Mexico. (Sandia National Labs., Albuquerque, NM (USA)). May 1988. Contract AC04-76DP00789. 24p. NTIS, PC A03/MF A01;1; GPO Dep. Order Number DE88012111/JAW.

Sandia National Laboratories interacts extensively with colleges and universities in New Mexico. This report briefly covers these relationships in employee education, research contracts, loaned equipment, temporary employment, and other areas. 10 tabs.

43277 (SOL—88-6) Deriving a utility function for the US economy. Technical report. Dantzig, G.B.; McAllister, P.H.; Stone, J.C. (Stanford Univ., CA (USA). Dept. of Operations Research). Apr 1988. Contract FG03-87ER25028. 72p. NTIS, PC A 04; 3; GPO Dep. Order Number DE88012421/JAW.

Given a general dynamic equilibrium formulation of a time staged model, we seek conditions on the distribution of utility functions of individuals which imply the model is equivalent to a mathematical program. Gorman and others long ago have observed that Engel curves of average consumption as a function of income at fixed prices are remarkably linear over a broad range of income of interest which tapers off at both ends of this range. We reproduce this phenomenon by assuming (a) that a general polynomial of the second degree has enough parameters (coefficients) to globally represent the utility functions of individual consumers, and (b) the distribution of utility functions that individuals have is independent of the income they happen to have. We achieve the latter by assigning values to the parameters of the utility functions by a random drawing with replacement from a population urn containing a representative sets of the parameters. We then derive the functional form of the per capita demand function and necessary and sufficient conditions for its integrability. Finally, we show in the context of the time staged model, that when the population is not too polarized as to its tastes at fixed income levels, a concave objective function always exists, which maximized subject to the physical flow constraints, implies the equilibrium conditions.

43278 (SOL—88-7) Formulation and solution of economic equilibrium problems. Stone, J.C. (Stanford Univ., CA (USA). Dept. of Operations Research). Apr 1988. Contract FG03-87ER25028. 82p. NTIS, PC A05/MF A01; 1; GPO Dep. Order Number DE88012422/JAW.

The author develop and assess a number of equivalent mathematical formulations of the general equilibrium problem in economics. We begin with the radiational representation as a nonlinear complementarity problem and develop alternative representations as nonlinear optimization problems. All of our formulations depart from previous approaches by including an explicit linear equality for price normalization and a matched artificial variable which must be zero at any equilibrium solution. This structure has the theoretical and computational advantage that any linearization of the equilibrium problem has a feasible complementary solution. Moreover, under a reasonable rank condition, a basic complementary solution exists which can be successfully computed by Lemke's amost-complementary pivoting method. We perform a number of computational experiments on two small problems from the literature. The results show considerable variation in the solution times for the various methods, but all methods succeed in locating an equilibrium, even from poor starting points. This successful performance (in addition to that reproted by other researchers) suggests that the kinds of general equilibrium models formulated in practice posses certain favorable computational properties that theoretical analysis has yet to discover.

2903 Environment, Health, And Safety

REFER ALSO TO CITATION(S) 42776, 42782, 42783, 42894, 43232, 43388, 43847, 43922

43279 (EUR—10633-EN) The state of the environment in the European Community 1986. (Commission of the European Communities, Brussels (Belgium)). 1987. 388p. Commission of the European Communities, Brussels, Belgium.

The report on the state of the environment in the European Community (1986) shows - within the limits of the available information - how the environment (in the Community of ten member states) has changed in recent years, particularly in the period since the adoption of the first Community Environment Programme. It follows two earlier reports published by the Commission in 1977 and 1979, linking the state of the environment with the development of the Commission's activities in the environmental field. The present report fulfils an undertaking given by the Commission to the European Parliament to develop an information base which can improve understanding both of changes in the Community environment, and the effects of Community policies, in the environmental field and also in other areas with an impact on the environment.

43280 (ORNL—6450/R6) Environmental regulatory update table, June 1988. Langston, M.E.; Nikbakht, A.; Salk, M.S. (Oak Ridge National Lab., TN (USA)). Jul 1988. Contract AC05-84OR21400. 127p. NTIS, PC A07/MF A01; 1; GPO Dep. Order Number DE88013332/JAW.

The Environmental Regulatory Update Table provides information on regulatory initiatives of interest to DOE operations and contractor staff with environmental management responsibilities. The table is updated each month with information from the Federal Register and other sources, including direct contact with regulatory agencies. Each table entry provides a chronological record of the rulemaking process for that initiative with an abstract and a projection of further action.

2904 Natural Resources

REFER ALSO TO CITATION(S) 42683

43281 (NEI-DK—74) Specifications of Mineral concessions and licences in Greenland as of June 30, 1987. (Ministeriet for Groenland, Copenhagen (Denmark)). Jul 1987. 22p. NTIS (US Sales Only), PC A03/MF A01. Order Number DE88752088/JAW.

The mineral Resources Administration carries out the major administrative tasks as regards mineral resources and hydro-power in Greeenland. The Act on Mineral Resources in Greenland distinguishes between 3 kinds of mineral rights - the prospecting licence, the exploration concession and the exploitation concession: A PROSPECTING LICENCE may be granted for a priod of not more than 5 years at a time and may include wide areas geographically. A prospecting licence gives the liecensee access to the performance of preliminary geological investigations. It is normally not connected with any exploration obligations. AN EXPLORATION CONCESSION contains exclusive rights and implies, in certain circumstances, a right of priority to the concessionaire with regard to any future grants of exploitation rights, provided that such exploitation concerns mineral deposits which have been found as a result of the exploration activities under the exploration concesseion. AN EXPLOITATION CONCESSION contains exclusive rights and will contain detailed terms regarding the anticipated exploitation activities. An updated specification of the concessions and licences in Greenland as of June 30, 1987 is enclosed. The list is divided into a. exclusive concessions and prospecting licences regarding other mineral resources than hydrocarbons and b. exclusive concessions and prospecting licences regarding hydrocarbons. (EG).

43282 **(NEI-NO—39) Proceedings UNESCO Symposium on Decision Making in Water Resource Planning. Vol. 1.** Carlsen, A.J. (ed.). (Norsk Hydrologisk Komite, Oslo (Norway)). Jan 1987. 324p. (CONF-8605333—Vol.1). NTIS (US Sales Only), PC A14. Order Number DE88752091/JAW.

From UNESCO symposium on decision making in water resource planning; Oslo, Norway (5 May 1986).

The report presents proceedings from the UNESCO symposium on decision making in water resources planning. Water is basic substance for all living beings. Even in ancient history we find examples of how man has developed available resources to recure supply and distribution of water for multiple use. Due to the increasing demand for water in our time for such purposes as energy production, irrigation, industrial water, recreation, fish etc., we now often face serious problems on how to optimise the use of the available resources. This makes the decision making process more and more important. The symposium discussed methods of how this process can be improved when the overall national or regional goal has been defined. Separate abstracts are prepared for six papers of the conference.

43283 **(NEI-NO—40) Proceedings UNESCO Symposium on Decision Making in Water Resource Planning. Vol. 2.** Carlsen, A.J. (ed.). (Norsk Hydrologisk Komite, Oslo (Norway)). Jan 1987. 411p. (CONF-8605333—Vol.2). NTIS (US Sales Only), PC A18. Order Number DE88752092/JAW.

From UNESCO symposium on decision making in water resource planning; Oslo, Norway (5 May 1986).

The report presents proceedings from the UNESCO symposium on decision making in water resources planning. Water is a basic for all living beings. Even in ancient history we find examples of how man has developed available resources to secure supply and and distribution of water for multiple purposes as energy production, irrigation, industrial water, recreation, fish etc., we now often face serious problems on how to decision making process more and more important. The symposium discussed zmethods of how this process can be improved when the overall national or regional goal has been defined. Separate abstracts are prepared for six papers of the conference.

43284 **(PB—88-199658/XAB) Geology, energy- and mineral-resources assessment of the Socorro Area, New Mexico. Report No. 1.** Krason, J.; Wodzicki, A.; Cruver, S.K.; Juilland, J.D.; King, P. (Bureau of Land Management, Denver, CO (USA)). Mar 1987. 80p. (BLM/YA/PT—87/003/3000). NTIS, PC A05/MF A01.

Geology, energy, and mineral (GEM) resource assessments were conducted in three wilderness study areas (WSAs) in Socorro County, in central New Mexico; Sierra Las Cansa, Veranito, and Stallion. The study assesses the potential for locatable, leasable, and salable energy and mineral resources within each WSA.

2905 Research, Development, Demonstration, And Commercialization

REFER ALSO TO CITATION(S) 42944, 43261, 43291, 43292, 43306, 43417, 43418, 43842

2906 Nuclear Energy

REFER ALSO TO CITATION(S) 42776, 42778, 42781, 42794, 42832, 42873, 43109, 43115, 43116, 43124, 43125, 43247, 43463

43285 **(IAEA-INFCIRC—348) Text of the joint U.S.-Soviet summit statement.** (International Atomic Energy Agency, Vienna (Austria)). Dec 1987. 13p. NTIS (US Sales Only), PC A03/MF A01. Order Number DE88701736/JAW.

Hard copies are available in English and Russian from IAEA Division of Publications, Distribution Unit.

The document reproduces the text of the joint U.S.-Soviet summit statement issued on 10 December 1987 at the conclusion of the meeting between the President of the United States and the General Secretary of the Central Committee of the Communist Party of the Soviet Union (Washington, December 7-10, 1987). It refers to the arms control (including nuclear weapons), human rights and humanitarian concerns, regional issues, bilateral affairs and further meetings.

43286 **(INIS-mf—11210, pp I4-I5) Utility requirements and system aspects of next generation power plants.** Loewenstein, W.B. (Electric Power Research Inst., Palo Alto, CA (USA)). Dec 1987. NTIS (US Sales Only), PC A13/MF A01. Order Number DE88780087/JAW. (CONF-871287—).

From Nuclear Societies of Israel annual meeting; Haifa, Israel (21 Dec 1987).

Transactions.; V. 14.

43287 **(INIS-mf—11210, pp I6-I8) BOT (Build-Operate-Transfer) model for building nuclear power stations in developing countries.** Yiftah, S. (Technion-Israel Inst. of Tech., Haifa. Dept. of Nuclear Engineering). Dec 1987. NTIS (US Sales Only), PC A13/MF A01. Order Number DE88780087/JAW. (CONF-871287—).

From Nuclear Societies of Israel annual meeting; Haifa, Israel (21 Dec 1987).

Transactions.; V. 14.

2908 Waste Heat Utilization

REFER ALSO TO CITATION(S) 42644, 43439, 43443

2910 Conservation

REFER ALSO TO CITATION(S) 43261, 43442

2920 Supply, Demand, And Forecasting

REFER ALSO TO CITATION(S) 43271, 43284, 43296, 43305

43288 **(EIU-SR—1089) China: energy sector outlook.** Johnson, T. (Economist Intelligence Unit, London (UK)). Jun 1987. 89p. British Library Document Supply Centre, Boston Spa, Wetherby, West Yorks. LS23 7BQ.

A detailed review is given of the current energy scene and of the future prospects for China. After discussing the outlook for the economy to 1990, the effects on energy production and consumption are considered. Particular attention is given to coal, oil and the fastest growing sector, electricity. Export prospects for oil and coal are discussed. Finally the prospects for foreign investment are discussed.

43289 **(IEE-SR—192) Energy prospect for the 21st century. Past, present and future of energy supply and demand.** (Institute of Energy Economics, Tokyo (Japan)). 10 Aug 1987. 498p. (In Japanese). NTIS (US Sales Only), PC A21. Order Number DE88752076/JAW.

About the course of Japan to the 21st century 3 scenarios were made, according to which future energy supply and demand in Japan were examined. The 3 scenarios are Standard, Gray and Rose. In Standard a socioeconomic model is assumed, in which present changes would continue almost as they are now and primary energy supply in 2000 would be 520 million kl in petroleum equivalent, substantially lower than 600 million kl in the present forecast by the government. Rose is the scenario of innovation and a leap. In Rose, adjustments of industries would progress rapidly and because of decrease in export and increase in import, production of energy-intensive, heavy and big industries would be reduced substantially. But primary energy supply would be about 8% and 40 million kl more in petroleum equivalent in 2000 than that in Standard. (183 figs, 198 tabs)

2930 Policy, Legislation, And Regulation

REFER ALSO TO CITATION(S) 42644, 42778, 42781, 42794, 43110, 43230, 43231, 43234, 43280, 43291, 43449, 43464

2940 Fossil Fuels

REFER ALSO TO CITATION(S) 42644, 42683, 43288, 43288, 43288, 43451

43290 **(DR—031983) An initial evaluation of COSP [Canada Oil Substitution Program] renewable converters.** (Decision Research Ltd., Winnipeg, Manitoba (Canada)). Mar 1983. 154p. (CE—01552). CANMET/TID, Energy, Mines and Resources Canada, 555 Booth St., Ottawa, Ont., Canada K1A 0G1; $0.34CAN per page, $3.40 CAN minimum.

This research was designed to study Canada Oil Substitution Program (COSP) adopters who have selected the renewables conversion option. Detailed questionnaires were mailed to five regions of Canada to those who had changed from oil to wood and/or propane for home heating. The specific objectives of the study were to gain an understanding of the renewables conversion decision process and any barriers that impede choice of renewable options, to determine the role of the COSP financial incentive in stimulating this decision process, to determine the extent of oil displacement achieved by conversions to wood or propane, and to recommend further research in the renewables conversion area. The perceived economic benefit was clearly the primary motivator behind the adoption and use of wood heating. The motives for propane conversions were not as clearly defined. Cost considerations, while important, were not cited as frequently by propane users. Regarding the extent of oil displacement, it was concluded that from 650 to 800 gallons of heating oil per year have been saved for the average Canadian household that converts from oil to wood for space heating and for off-oil propane users 825 gallons of oil per year. Of the attempt to determine the impact of the COSP incentive in stimulating renewable conversions, results suggest that COSP is not a sufficient condition for conversions to take place, particularly among wood users. On the one hand, COSP may be superfluous; the vast majority of subjects claim they would have converted without COSP. It is recommended that the conversion resistant segment of oil users be studied in the near future to discern the importance of COSP as a conversion stimulus. 46 tabs.

43291 **(EMR—1982) Resoponse of the Department of Energy, Mines and Resources to the Report of the Special Committee of the House of Commons on Alternative Energy and Oil Substitution.** (Department of Energy, Mines and Resources, Ottawa, Ontario (Canada)). 1982. 55p. (CE—01591). CANMET/TID, Energy, Mines and Resources Canada, 555 Booth St., Ottawa, Ont., Canada K1A 0G1; $0.34CAN per page, $3.40 CAN minimum.

This report supplies a commentary on a previous report concerning Canada's options for reducing dependence on oil. Energy conservation options are examined as one of the most important, and a number of initiatives described in this report go beyond the recommendations of the previous report. These include programs supporting more energy efficient buildings, oil substitution for home heating, renewable energy sources, and supplying energy audits and financial incentives to encourage industrial energy conservation. The second part of this report covers alternative transportation fuels, focusing primarily on methanol. This receives attention since it can be produced from a variety of readily available feedstocks, using feasible techniques still being developed, and appears to be effective not only as a vehicle fuel but also as a feedstock for petrochemicals and as a gasoline extender. Other alternatives considered are coal liquefaction, gas fuels, and electric vehicles. The next 2 parts examine the roles of electricity and hydrogen. New electric generation technologies are being examined, and research and development in hydrogen is described; emphasis is given to advancing the date when electrolytic hydrogen can replace fossil-fuel-derived hydrogen. Significant advances are needed before hydrogen becomes viable as an alternate transportation fuel. With respect to solar power, significant opportunities are present and expanded research is warranted. Government has a valuable role to play in commercialization of all these new technologies and several strategies have been developed to fulfill this role.

43292 **(EMR/M—ADM716) Research and development as an incentive to Canadian fossil fuel development.** (Department of Energy, Mines and Resources, Ottawa, Ontario (Canada). Mines Branch). Dec 1971. 23p. (CE—01611). CANMET/TID, Energy, Mines and Resources Canada, 555 Booth St., Ottawa, Ont., Canada K1A 0G1; $0.34CAN per page, $3.40 CAN minimum.

This report presents an outline of the energy supply problem facing North America from the Canadian perspective and suggests ways in which research programs can be developed to encourage exploration and development of new energy sources, make more efficent use of energy, ensure improvement of safety standards in the energy industry, and reduce pollution. Specific programs applicable to coal and coke are sketched along with their possible impacts and the role of government incentives. In the field of coal exploration, a significant advance would be any improvement in assessing coal quantity and quantity by drill coring. Coal processing techniques need to be improved especially with regard to fine particles. Coking processes and coke properties need research, especially in view of the potential for coke exports. Many opportunities are identified in coal utilization, including coal products used as reducing agents and synthetic gas production. Safety and pollution problems that need to be addressed include removal of mineral matter and proper storage and mining methods.

43293 **(INA—1983) Beaufort Sea hydrocarbon exploration. A federal perspective.** (Department of Indian and Northern Affairs, Ottawa, Ontario (Canada)). 1983. 28p. (CE—01531). CANMET/TID, Energy, Mines and Resources Canada, 555 Booth St., Ottawa, Ont., Canada K1A 0G1; $0.34CAN per page, $3.40 CAN minimum.

This report provides a brief overview of hydrocarbon exploration undertaken in the Canadian Beaufort region, describes the environmental and socio-economic milieu, and cites federal accomplishments in introducing and administering environmental legislation and monitoring oil and gas activities. In addition, it sets forth some broad objectives and guidelines intended to facilitate hydrocarbon exploration, and to ensure that it can proceed in a socially and environmentally responsible manner. The guidelines suggest good practices that should be followed by anyone exploring for oil and natural gas in the Beaufort region and other parts of northern Canada. They are, in large measure, based on current industrial practices. 10 figs.

43294 **(NP—8770256) Hard coal mining in the 1960's and 1970's. A contribution to structural adaptation.** Mohr, B. (Erlangen-Nuernberg Univ., Erlangen (Germany, F.R.). Wirtschafts- und Sozialwissenschaftliche Fakultaet). 11 Nov 1986. 196p. (In German). NTIS (US Sales Only), PC A09. Order Number DE88770256/JAW.

It is the intention of this treatise to present, in the light of the endeavours of the Ruhr coal mining in the 1960's and 1970's to

overcome the structural crisis, to which waste of politico-economic resources an adjustment to the decrease in demand by anything other than criteria of market economy can lead. As in the development in the Ruhr area, the investigation is divided into two classifications: In the 1960's the adjustment measures of the mining companies were fundamentally influenced by the fact that sales of Ruhr coal were organised centrally and the companies were given sales quotas according to their capacity. With this all companies were hit equally by the decrease in demand, independent of their productivity. The adjustment measures resulting from this, about all the closing down of shafts, led inevitably to a less than optimal result, for the boundary works were not established, rather the closures were carried out on the basis of specific company-political considerations. As the result of the attempts at adjustment being unsatisfactory, the Federal Government decided, in 1968, on a fundamental change in structure of mining in the Ruhr. The mining companies were to be combined in a collective company whose task it would be, to adjust mining in the Ruhr systematically to the market situation. Therefore, in the second part of this treatise, it will be examined, whether the foundation of Ruhr Coal Ltd. has been able to fulfil its task of making coal from the Ruhr competitive again. (orig./UA)

43295 (NP—8770262) Method for assessing the chances of success of R + D activities in coal mining from the technical and economic point of view. Heising, F. (Technische Univ. Berlin (Germany, F.R.). Fachbereich Bergbau und Geowissenschaften). 31 Jan 1986. 161p. (In German). NTIS (US Sales Only), PC A08. Order Number DE88770262/JAW.

The treatise in hand deals with the development and explanatory presentation of a method of assessing research, development and innovation schemes and the creation of an order of priority in general, in certain promotion programmes or according to other certain selection criteria. It is necessary to develop and present a method which can fulfil maximal requirements to an optimal extent. For this, the most suitable method is a system of assessment as in the polydimensional method of assessment matrixes. As primary solution measure for assessment, an assessment matrix is developed with 10 different single criteria, primarily dealing with all aspects of mining requirements, which are assessed by point values p from 0-5 and evaluation factors f from 1-5 according to the significance of the criterium for the three different types of planning (t = technical-economical, s = security-ergonomical, g = orientated to fundamentals and future) which must be specially regarded and evaluated. The second step of the procedure deals then with the evaluation of the assessment results to create a plausible order of priorities which can be assimulated at any time. With the help of six different computation methods, the evaluation results of seven different evaluators for 18 research and development schemes are put into order of priority, during a trial-run, as decision assistance for the decision-makers. (orig./UA)

43296 (RFW—TP3833E) Assessment of the quality and supply limits of conventional transportation fuels. (Webb (R.F.) Corp. Ltd., Ottawa, Ontario (Canada)). Aug 1982. 80p. (CE—01580). CANMET/TID, Energy, Mines and Resources Canada, 555 Booth St., Ottawa, Ont., Canada K1A 0G1; $0.34CAN per page, $3.40 CAN minimum.

The report presents a view of the oil supplies available to Canadian refiners to the year 2,000 and changes in the anticipated supply, demand and quality of transport fuels. In the most likely scenario domestic production of oil will not be adequate to meet demand in 1990, and the gap between supply and demand must be filled by imports and by alternative fuels not based on oil. While vigorous action now could close the supply/demand gap by 2000, it is likely that imports will still be necessary. Major changes are forecast in refinery operations due to a decreased demand for gasoline and a decrease in the ratio of leaded to unleaded gasoline. A phase-out in the use of lead in gasoline, if legislated, would require large investments and refinery changes. Highway diesel and jet fuel demand is expected to increase sharply. The demand can be met readily in the Atlantic refineries from high grade Hibernia crude, but with difficulty elsewhere, and a relaxation in specifications and/or investments to upgrade low quality distillates to transport fuel grades is anticipated. Rail, marine and stationary engine use of diesel fuel will also increase, but these applications can utilize lower ignition quality fuels. New refinery capacity will be required in the west, much of which will incorporate facilities for the upgrading of low quality distillates to transport diesel fuels. The report contains an analysis of transport fuel quality and supply in a scenario (which emphasizes the highway and air modes) where Canada is regarded as four refining regions, each supplied by a given slate of domestic and/or foreign crude oil to meet a forecast level of demand. A note is provided on the possible adoption of propane, compressed natural gas and alcohols as transport fuels in the period to 2000. 13 figs., 11 tabs.

2960 Electric Power

REFER ALSO TO CITATION(S) 42894, 43282, 43283, 43288, 43919, 43920, 43921

43297 (EPRI-EM—5633-Vol.2) DSM [demand-side management] commercial customer acceptance: Volume 2, Survey and database documentation: Final report. George, S.S.; Kirksey, W.E.; Skelton, J.C. (XENERGY, Inc., Oakland, CA (USA); Battelle Columbus Div., OH (USA)). Apr 1988. 310p. Research Reports Center, Box 50490, Palo Alto, CA 94302. Order Number TI88920268/JAW.

A survey was conducted among utility DSM (demand-side management) program managers to gather information on the characteristics of commercial sector programs. The survey data were used in part to identify the important factors that influence customer participation in such programs. Information was gathered in the following general areas of interest: (1) program characteristics (e.g., program type, objectives, status, etc.); (2) marketing characteristics (e.g., promotional mechanisms, budget, goals, etc.); (3) customer eligibility and participation (e.g., characteristics of the eligible population, participation by customer category, etc.); and (4) market research information (e.g., the data that pertain to the effectiveness of the progress). The survey obtained information on 108 DSM programs covering a broad range of options, including audits, non-audit information, financial incentive, direct load control, distributed local control, thermal energy storage, time-of-use rates, and other rate programs. Program planners can use the survey database, presented in its entirety in this report, to identify utilities that have already implemented DSM programs of interest and to learn from their experience.

43298 (EPRI-P—5402-Vol.1) Multiobjective Integrated Decision Analysis System (MIDAS): Volume 1, Model overview: Final report. Farber, M.; Brusger, E.; Gerber, M. (Temple, Barker and Sloane, Inc., Wellesley Hills, MA (USA); Gerber (M.S.) and Associates, Inc., Columbus, OH (USA)). Apr 1988. 63p. Research Reports Center, Box 50490, Palo Alto, CA 94303;1. Order Number TI88920272/JAW.

MIDAS (Multiobjective Integrated Decision Analysis System) is an innovative utility planning tool that facilitates the analysis of risk. Three features distinguish this framework from other planning models: it incorporates a generalized decision analysis approach; it includes a completely integrated planning model for demand-supply evaluation; and the complete model runs on a microcomputer. 24 figs.

43299 (Juel-Spez—398) Industrial electric power demands up to the year 2000. An analysis and forecast of electric power demands in different industrial sectors (mining, inclusive). Jobsky, T.; Pohlmann, M. (Kernforschungsanlage Juelich G.m.b.H. (Germany, F.R.). Programmgruppe Systemforschung und Technologische Entwicklung). May 1987. 300p. (In German). NTIS (US Sales Only), PC A13/MF A01. Order Number DE88753781/JAW.

Part one of the study gives a general survey of energy economy and its situation in industry. The discussion aims at giving a first impression of the overall industrial energy demand structure and the energy demand structure of about 40 sectors of industry classified by four main groups. Part two discusses the developmental trends of selected trans-sectoral electric power uses determining the electric power demand. The trends referred to include the development of lighting and mechanical engineering, pollution abate-

ment regulations, mechanisation and automation with robotics and data processing as the dominant technologies, and heat recovery measures. Part three investigates into the electric power demand of individual sectors. The assessment of the respective developments of end-use energy consumption and energy source structures during the past decades allows to determine the status of electric power within the energy supply of a given industrial sector. The analysis is followed by a summary of the major features of electric power uses within the individual sectors concerned. The conclusion is dedicated to a general discussion and evaluation of the results obtained comparing the latter with other forecasts relevant to the subject. (orig./UA)

43300 **(NP—8770252) Calculation of time-dependent electric power costs.** Steffen, T. (Technische Univ. Berlin (Germany, F.R.). Fachbereich 19 - Elektrotechnik). 5 Feb 1987. 103p. (In German). NTIS (US Sales Only), PC A06/MF A01. Order Number DE88770252/JAW.

According to existing laws, electric power must be available to everybody at low-cost and cost-oriented tariffs subject to governmental control. In order to avoid an internal subventioning within the different groups of users, cost-oriented prices, i.e. prices taking into account the respective electric power consumption, should also be granted customers who are not supplied on the basis of general tariffs (special contract customers). The thesis deals with a method allowing to give the momentary kWh producing costs whenever required. The momentary prices determined can be made available to the user, and thus be made the basis of the much suggested 'spot prizing' method. Different daily load curves show the changes of kWh producing costs in the course of one day. The effect of additional measures such as power plant pollution control requirements on kWh producing costs can be read directly. (orig./UA)

2980 Consumption And Utilization

REFER ALSO TO CITATION(S) 43300

43301 **(SERC-GR/C—10261) Analysis of domestic energy consumption database.** Torrance, V.B. (Science and Engineering Research Council, Swindon (UK)). Mar 1986. 14p. British Library Document Supply Centre, Boston Spa, Wetherby, West Yorks. LS23 7BQ.

Analysis of over 300 residential buildings across the UK for energy consumption and attempts to relate the consumption to building form, orientation, user patterns and internal temperatures are reported. It is concluded that physical factors are not able to explain a high proportion of the variances in energy consumption found in domestic properties.

2990 Unconventional Sources And Power Generation

REFER ALSO TO CITATION(S) 42903, 42996, 43030, 43033, 43290

43302 **(MA—041976) Canada's renewable energy resources. An assessment of potential.** Middleton, P.; Argue, R.; Burrell, T.; Hathaway, G. (Middleton Associates, Toronto, Ontario (Canada)). Apr 1976. 516p. (CE—01621). CANMET/TID, Energy, Mines and Resources Canada, 555 Booth St., Ottawa, Ont., Canada K1A 0G1; $0.34CAN per page, $3.40 CAN minimum.

Rising costs of conventional, frontier and nuclear energy production and the prospect of future shortages have prompted a resurgence of interest in alternative, renewable energy technologies. This study constituted a preliminary step in determining which sources, technologies and applications may be appropriate in Canada, and when and under what conditions they might be technically and economically viable. Principal sources of renewable energy (solar radiation, wind and biomass), as well as waves, thermal gradients and sensible heat sources are reviewed to establish, in general terms, their significance in the Canadian context. Next, the technical characteristics, efficiency, costs, impacts and state-of-the-art of sixteen harnessing or conversion technologies are presented as an information base upon which to build an assessment of potential. A method of comparing the life cost of a renewable energy system to that of the likely conventional alternative is proposed and applied in cases where adequate technical and economic data are available. A variety of different economic assumptions are also outlined under which the renewable systems would be cost competitive. This costing methodology is applied in detail to four case studies: residential solar space and water heating, photovoltaics, residential, a 200 kW wind generator, and anaerobic digestion of livestock wastes. Finally, the potential for renewable energy approaches in Canada is explored and evaluated from three perspectives: technical viability, economic viability and implementation. 319 refs., 18 figs., 94 tabs.

43303 **(NRC/E—091983) Technical and economic considerations in the use of solar as a primary energy source in Canada.** Tolmie, R.W. (National Research Council of Canada, Ottawa, Ontario. Div. of Energy). Sep 1983. Vp. (CE—01541). CANMET/TID, Energy, Mines and Resources Canada, 555 Booth St., Ottawa, Ont., Canada K1A 0G1; $0.34CAN per page, $3.40 CAN minimum.

A solar energy system is described which, if put to widespread use, could provide for a major part of Canada's needs for electricity, process heat and space heating. The key element is a seasonal heat storage facility designed for high useable energy capacity per unit volume. The collectors and converters would be adaptations of existing designs. The power output can be varied to suit the load, including power rates much higher than the input rate from the collectors. If salt is used as the energy storage medium, its low cost and availability in very large quantities make it suitable for use on a massive scale, while the ease with which it can be contained, its high energy storage capacity and its ideal transition temperature contribute to its suitability for the application. Such a system can provide a true alternative to fossil fuels and nuclear sources. Preliminary indications are that the costs would be competitive, and the research and development needed to develop such a system would be modest in relation to its benefits. 35 refs., 15 figs., 2 tabs.

43304 (RISO-M—2510, pp 229-233) **Research on demands for stand-alone wind energy conversion systems.** Lembke, J. (Visionik ApS, Charlottenlund DK). May 1987. NTIS (US Sales Only), PC A12/MF A01. Order Number DE88752922/JAW. (CONF-8705276—).

From Workshop of the European cooperative networks on rural energy on wind energy applications for rural areas; Roskilde, Denmark (14 May 1987).

CNRE Bulletin, 13.

43305 (RISO-M—2510, pp 251-264) **Rural energy survey in Zambezi, Zambia.** Christensen, J.M. (Energy Systems Group, System Analysis Department, Risoe National Laboratory DK). May 1987. NTIS (US Sales Only), PC A12/MF A01. Order Number DE88752922/JAW. (CONF-8705276—).

From Workshop of the European cooperative networks on rural energy on wind energy applications for rural areas; Roskilde, Denmark (14 May 1987).

CNRE Bulletin, 13.

This paper is a preliminary presentation of the results and experiences obtained during a study in Zambia. The study is one of the major parts of the Ph.D. project - Methods for Assessment of Energy Projects in Developing Countries - currently being performed by the author at the Systms Analysis Department, Risoe National Laboratory, in collaboration with the Technical University of Denmark. This study, as well as the rest of the Project, is organized in close collaboration with the Department of Energy in Lusaka, Zambia, where the Rural and Household Energy Devleopment Section has integrated the project in its plans. Silvester Hibajene from the section participated in the 3 weeks of data collection in the district of Zambezi.

43306 (RISO-M—2510, pp 265-274) **Wind energy activities in CNRE, related international projects and cooperation between test stations.** Petersen, H. (Test Station for Windmills, Department for Meteorology and Wind Energy, Risoe National Laboratory DK). May 1987. NTIS (US Sales Only), PC A12/MF A01. Order Number DE88752922/JAW. (CONF-8705276—).

From Workshop of the European cooperative networks on rural energy on wind energy applications for rural areas; Roskilde, Denmark (14 May 1987).
CNRE Bulletin, 13.

30 DIRECT ENERGY CONVERSION

43307 (INIS-mf—11210, pp V25-V28) **Liquid-metal and conversion of nuclear energy to electricity reviewed.** Greenspan, E.; Barak, A.; Blumenau, L.; Branover, H.; El-Boher, A.; Spero, E.; Sukoriansky, S. (Israel Atomic Energy Commission, Tel Aviv; Ben-Gurion Univ. of the Negev, Beersheba (Israel). Center for MHD Studies). Dec 1987. NTIS (US Sales Only), PC A13/MF A01. Order Number DE88780087/JAW. (CONF-871287—).

From Nuclear Societies of Israel annual meeting; Haifa, Israel (21 Dec 1987).
Transactions.; V. 14.

43308 **Liquid-sodium thermoacoustic engine.** Migliori, A.; Swift, G.W. (Condensed Matter and Thermal Physics Group, Los Alamos National Laboratory, Los Alamos, New Mexico 87545). *Applied Physics Letters;* **53**: No. 5, 355-357(1 Aug 1988).

We have constructed a thermoacoustic engine that uses liquid sodium as its working substance. The engine generates acoustic power using heat flowing from a high-temperature source to a low-temperature sink. The measured performance of this engine disagrees significantly with numerical calculations based on our theory of thermoacoustic engines. The efficiency of the engine is a substantial fraction of Carnot's efficiency, and its power density is comparable to that of the conventional heat engines in widespread use. Thus we expect this type of engine to be of practical, economic importance.

3005 Fuel Cells

43309 (CONF-850511—Absts., pp 1-3) **Status of fuel cell technologies.** Fickett, A.P.; Gillis, E.A. (Electric Power Research Institute, Palo Alto, CA (USA)). 1985. NTIS, PC A14/MF A01. Order Number DE88008297/JAW.

From Fuel cell seminar; Tucson, AZ, USA (19 May 1985).
The development of fuel cells by research organizations and industrial firms in the US has been underway for about twenty-five years. Most of this work has focused on five types of fuel cells, characterized by the type of electrolyte used, and these are: solid polymers, alkaline, phosphoric acid, molten carbonate, and solid oxide. The preferred fuel cell technology for a specific application is influenced by the fuel to be used (and how the fuel cell integrates with the fuel handling and processing equipment) and by trade-offs between the power density, energy density, and efficiency of candidate systems. While the related system components such as fuel processors and power conditioners have represented a significant fraction of the past fuel cell development efforts, the prerequisite to the successful application of any technology is achieving the performance, cost and durability targets of the fuel cell stacks. The paper describes the progress that has been made in the various fuel cell technologies, the current focus of national R & D activities, and provides comments from the EPRI viewpoint of the work that needs to be completed if fuel cells are to be successful in the marketplace.

43310 (CONF-850511—Absts., pp 4-5) **Fuel cells and the utility industry.** Matson, K.L. (Public Service Electric & Gas Co., Newark, NJ (USA)). 1985. NTIS, PC A14/MF A01. Order Number DE88008297/JAW.

From Fuel cell seminar; Tucson, AZ, USA (19 May 1985).
Fuel cell power plants are expected to provide one set of benefits to electric utilities and a second set to gas utilities. While both sets of benefits may coincide in some aspects, there may be other areas which offer conflicts between gas and electric interests. A combination utility such as PSE & G must be able to balance the conflicts as well as enjoy the coincident benefits. This paper discusses the plans that PSE & G is formulating for integrating the two different types of fuel cells into its system. Dispersed generators are power plants sited near energy users, in sizes necessary to provide the desired energy services, and operated in a manner to minimize costs of all energy services whether they are stand-alone units or interconnected with other energy supplies. Thermionic or thermoelectric generators require complex bottoming cycles to achieve similar efficiencies, and emissions and part power efficiencies are still inferior. The PSE & G involvement in fuel cells and the involvement of other gas, combination and electric utilities, has been continuous since the mid-60's, but these efforts still have not commercialized the initial fuel cell technology - i.e., the phosphoric acid plants for dispersed generation. While the 4.8 MW and 40 kW results indicate that the plant demonstration phase is nearly completed, it will take further involvement by pioneering utilities to surmount the next barriers - the high cost of commercial prototype units whether at 200 kW or 7.5 or 11 MW - before the benefits of the fuel cell can be realized by the majority of utilities.

43311 (CONF-850511—Absts., pp 6-9) **Overview of fuel cell R and D in Japan.** Narimatsu, Y.; Higuchi, N.; Simuzu, M.; Nagashima, M. (Agency of Industrial Science and Technology, Tokyo (Japan)). 1985. NTIS, PC A14/MF A01. Order Number DE88008297/JAW.

From Fuel cell seminar; Tucson, AZ, USA (19 May 1985).
R & D on fuel cells in Japan is supported mainly by the government as a national project, but activities by private companies are also energetic. The program, which is included in the national Moonlight Project, was initiated in 1981 and has progressed successfully. Two 1000 kW PAFC power plants are presently under construction; two 1 kW models of MCFC's were tested and the design of a 10 kW model will be completed by the end of this year. As to alkaline fuel cells, the projection has been completed successfully; a 1 kW model was constructed and tested, and the specification targets were fulfilled. A 500 W stack of a SOFC will be assembled this year. Most of the other activities not included in the MLP are focused on the R & D of PAFC's and MCFC's which are supported by electric or gas utilities.

43312 (CONF-850511—Absts., pp P1.1A-P1.1B) **Technology development for internal reforming MCFC power plants.** 1985. NTIS, PC A14/MF A01. Order Number DE88008297/JAW.

From Fuel cell seminar; Tucson, AZ, USA (19 May 1985).
During the past year and one-half, IGT has been working in several task areas: development and optimization of tape-casting for electrolyte matrix production; evaluation of internal methane reforming catalysts; definition of component development requirements for MCFC stacks; methods for improving the creep resistance of the anode; and in cell evaluation of alternate cathode materials and of methods for controlling NiO dissolution. The materials tested and the progress in each area are briefly discussed.

43313 (CONF-850511—Absts., pp P1.2A-P1.2E) **Modeling of internal reforming direct fuel cell.** Wilemski, G.; Ghezel-Ayagh, H.G.; Patel, P.S.; Maru, H.C. (Physical Sciences Inc., Andover, MA (USA)). 1985. NTIS, PC A14/MF A01. Order Number DE88008297/JAW.

From Fuel cell seminar; Tucson, AZ, USA (19 May 1985).
A cell performance model has been developed to describe direct methane-fueled molten carbonate fuel cells (Direct Fuel Cell, DFC) under isothermal or adiabatic conditions. The model treats finite-rate methane reforming kinetics and is based on an earlier model in which methane was either inert or in full equilibrium with the remaining gas species. The isothermal model serves as a diagnostic tool to predict performance of single cells. By correlating the cell design parameters with the cell performance characteristics, the model provides a direction for improving the cell technology. The adiabatic model provides the means to study the effects of changes in design or operating conditions on DFC stacks. For example the adiabatic model can be used to evaluate different stack design options such as the type of flow geometry. The major features of the

model, along with a range of experimental data used to verify it, are presented.

43314 (CONF-850511—Absts., pp P1.3A-P1.3D) **Material studies on molten carbonate fuel cells.** Kodama, T.; Miyazaki, Y.; Tanase, S.; Yanagida, M.; Tanimoto, K.; Kose, S. (Government Industrial Research Institute, Osaka (Japan)). 1985. NTIS, PC A14/MF A01. Order Number DE88008297/JAW.

From Fuel cell seminar; Tucson, AZ, USA (19 May 1985).

The surveying efforts of electrode and electrolyte matrix materials are continued, and the physical properties data such as melting point, electric conductivity, vapor pressure etc. are being accumulated for binary or ternary systems of carbonate electrolytes. Fe-based or Ni-based alloys and electric conductive ceramics for electrodes, and non or ionic conductive ceramics for electrolyte matrix were investigated. Over a hundred kinds of materials have been surveyed so far. Corrosion products on each specimen was investigated by SEM photograph and X-ray analysis. In addition, corrosion tests of a wide variety of oxides were carried out and the oxides were analyzed by XRD.

43315 (CONF-850511—Absts., pp P1.4A-P1.4D) **Development status of molten carbonate fuel cell.** Murahashi, T.; Hirata, I.; Nishiyama, E.; Kishida, K. (Mitsubishi Electric Corp., Hyogo (Japan)). 1985. NTIS, PC A14/MF A01. Order Number DE88008297/JAW.

From Fuel cell seminar; Tucson, AZ, USA (19 May 1985).

Molten carbonate fuel cell development program is one of the highest priority R & D programs in Mitsubishi Electric Corporation. The major effort has been focused on achieving high performance, high durability and cost effective MCFC system development. A number of out-of-cell and in-cell testings as well as stack testings have been conducted to ensure basic component material characteristics, fabrication technique, cell design and stack design. This paper reports on the results of long period operation of a MCFC single cell and some performance results of a 5-cell-stack.

43316 (CONF-850511—Absts., pp P1.5A-P1.5E) **Conceptual study on a 500 MWe class coal-gasified MCFC power generating system.** Yoshida, T.; Ogoshi, M.; Hosaka, M.; Uematsu, H.; Sugitani, T. (Ishikawajima-Harima Heavy Industries Corp., Tokyo (Japan)). 1985. NTIS, PC A14/MF A01. Order Number DE88008297/JAW.

From Fuel cell seminar; Tucson, AZ, USA (19 May 1985).

Japan, relying largely on imported fuel for its energy needs, should seek the diversification of the sources available for energy. In parallel with the development of nuclear power generation, more extensive utilization of coal has become a matter of increasing urgency. One promising means of using coal without creating pollution is its gasification. Among many power generating systems, MCFC is highly compatible with this form of coal utilization. This report outlines some results obtained from a conceptual study undertaken in IHI on a 500 MWe class coal-gasified MCFC power generating system.

43317 (CONF-850511—Absts., pp P1.6A-P1.6D) **Status of molten carbonate fuel cell performance in Japan.** Watanabe, T.; Ishikawa, R.; Horiuchi, N. (Central Research Institute of Electric Power Industry, Tokyo (Japan)). 1985. NTIS, PC A14/MF A01. Order Number DE88008297/JAW.

From Fuel cell seminar; Tucson, AZ, USA (19 May 1985).

Central Research Institute of Electric Power Industry (CRIEPI) has been testing more than twenty molten carbonate fuel cells and stacks (MCFC) offered by several developers in Japan since 1982. Main purpose of these tests is to obtain the experimental performance data of up-to-date MCFC, thereby estimating the optimum operating conditions for the future power plants in the electric utilities. This paper summarizes the test results of four bench-scale single cells developed by Hitachi. Ltd., Toshiba Corp., Mitsubishi Electric Corp. and Fuji Electric Co., Ltd.

43318 (CONF-850511—Absts., pp P1.7A-P1.7D) **Environmental effects on structural materials used in the solid oxide fuel cell system.** Spengler, C.J. (Westinghouse Research and Development Center, Pittsburgh, PA (USA)). 1985. NTIS, PC A14/MF A01. Order Number DE88008297/JAW.

From Fuel cell seminar; Tucson, AZ, USA (19 May 1985).

Successful operation of solid oxide fuel cell electric generator systems over long time periods requires use of structural materials which would have sufficient environmental stability that these components do not become life limiting for the generator. In generator designs under consideration, critical structural components are the metal canister (separates the fuel gas from the bulk of the generator thermal insulation), insulation, ceramic structural parts and current collection materials. The canister will be exposed to fuel or partially spent fuel gas on the inner surface and an oxidizing (sweep gas, combustion gas) environment on the outer surface at metal temperatures from 700 to 1100°C. Experiments were performed to examine the possibility that hydrogen permeation through the metal canister wall from the fuel gas side would affect the oxidation behavior and metallurgical stability of the high temperature alloy. The experiments also simulated possible chemical transport mechanisms. The ceramic structural and insulation materials and nickel current collection components were subjected to a flowing gas of variable P/sub O_2/ and P/sub H_2O/ producing possible chemical transport reactions. The experiments, as a result of almost 1200 hours of exposure, showed: (1) little effect of hydrogen permeation on the stability of grain boundary carbides; (2) the oxidation products on the exterior wall of the partition were influenced by hydrogen permeation through the alloy; and (3) there was some evidence that elements from the oxide scale on the Inconel-600 and the alumina insulation were transported in the wet fuel gas atmosphere.

43319 (CONF-850511—Absts., pp P1.8A) **Mathematical modeling of a solid electrolyte tubular flow fuel cell.** Rincon-Rubio, L.M.; Nguyen, B.C.; Mason, D.M. (Stanford Univ., CA (USA)). 1985. NTIS, PC A14/MF A01. Order Number DE88008297/JAW.

From Fuel cell seminar; Tucson, AZ, USA (19 May 1985).

The equations governing mass transfer in a tubular flow solid oxide electrolyte reactor have been numerically solved by a finite difference technique for any arbitrary gaseous electrochemical reaction rate expression at the tube wall. A reactor has been experimentally tested to obtain electrocatalytic mechanisms at the oxygen cathode as well as the hydrocarbon fuel anode. Yttria and Scandia stabilized zirconia tubes were used as electrolytes whereas porous Au and Pt were employed as electrodes. The cell was operated in the temperature range 550-900°C. The experimental findings have been used to check the validity of the proposed mode. The results should permit a better understanding of the behavior of a practical tubular solid oxide electrolyte fuel cell, allowing optimization of operating parameters.

43320 (CONF-850511—Absts., pp P1.9A-P1.9B) **Low cost hydrogen/air fuel cell system.** Emery, A.T.; Warszawski, B. (Occidental Petroleum Corp., Niagara Falls, NY (USA)). 1985. NTIS, PC A14/MF A01. Order Number DE88008297/JAW.

From Fuel cell seminar; Tucson, AZ, USA (19 May 1985).

The program described is now entering the final phase of engineering development; that of incrementally raising the level of power output while verifying life performance at full commercial scale. Much of the recent work, has been directed toward making the fuel cell adaptable to either circulating acid or alkaline electrolytes. The acid system, although sacrificing a small amount of power output, insures a longer, more stable, lifetime. The acid cell can also use, as direct feed, hydrogen fuels containing relatively large amounts of carbon dioxide as well as modest levels of carbon monoxide. Component lives of 10,000 - 15,000 continuous hours of stable operation have been logged, while polyelement stacks made from full scale components have recently reached levels of continuous operation of about 1500 hours. On the basis of tests underway, the life of the acid cell will be over 2 years, and the alkaline cell over 1 year. The power density of a full scale acid cell is presently at 7.4 watts/dm^2 with a goal 8.4 w/dm^2; the alkaline cell at 10.1 watts/dm^2 with a goal 12 w/dm^2. The system modifications needed

to reach full output for both systems are straight forward and readily achievable. Cell assembly procedures have been sufficiently developed in the French pilot manufacturing facility to insure that the device can be mass produced on high speed machinery resulting in unusually low stack costs; i.e. under $50/kw less catalyst. A substantial body of manufacturing cost data to demonstrate this have been developed.

43321 (CONF-850511—Absts., pp P1.10A-P1.10D) **Low cost solid polymer electrolyte fuel cell.** Watkins, D.S.; Harkness, A.C.; Gardner, C.L. (Ballard Technologies Corp., Vancouver, British Columbia (Canada)). 1985. NTIS, PC A14/MF A01. Order Number DE88008297/JAW.

From Fuel cell seminar; Tucson, AZ, USA (19 May 1985).

The objective of the BTC program is the development of a low cost technology and hardware capable of operating on air and an impure hydrogen from methanol reforming. The demonstration phase of the present contract will culminate in the delivery to DREO in March 1986 of 72 W fuel cell stacks with the characteristics shown in Table 1 as Development Stack. Sufficient design information will have been accumulated so that the Development Stack could be scaled up to 1000 W. Also shown in Table 1 as Manufacturing Stack are the characteristics of a 5000 W unit with improved performance which would be commercially viable. The design and construction of the 5000 W unit will be done in a separate program. Cost estimates, based on the performance goals are included in Table 1. These costs are in 1984 US dollars. In order to meet the goals, special attention is being paid to the following areas: material selection and engineering design; solid polymer electrolytes; and electrocatalysts. The project status is described.

43322 (CONF-850511—Absts., pp P1.11A-P1.11D) **High temperature regenerative H_2S removal with novel mixed oxide sorbents for fuel cell applications.** Tamhankar, S.S.; Bagajewicz, M.J.; Gavalas, G.R.; Sharma, P.K.; Flytzani-Stephanopoulos, M. (California Institute of Technology, Pasadena (USA)). 1985. NTIS, PC A14/MF A01. Order Number DE88008297/JAW. Contract AI21-83MC20417.

From Fuel cell seminar; Tucson, AZ, USA (19 May 1985).

The present study aims at developing H_2S sorbents combining several desirable physicochemical properties. Through this work, certain mixed oxide sorbents have been developed so that rapid kinetics of absorption and good sorbent regenerability are achieved during operation at 500-700°C. A special preparation technique involving pyrolysis of homogeneous organic precursors was used to synthesize these sorbents as highly dispersed solid compounds characterized by small crystallite size ($\sim$ 0.1 μm), large pore volume ($\sim$ 2.0 cc/g), and relatively high surface area (> $10m^2/g$). Rapid absorption kinetics and limited pore plugging may, thus, be expected on sorbents with these specific physical properties. The novel sorbents studied in this work include ferrites, aluminates, molybdates (and mixtures thereof) of zinc and copper. The experiments consisted of consecutive sulfidation and regeneration runs at 1 atm pressure. The feed gas used in sulfidation contained 15-20 mol% H_2, 7-25 mol% H_2, 0.2-1% mol% H_2S, balance N_2 at a space velocity of 2000 hr^{-1}. The temperature used was in range of 500-700°C and was held fixed for the duration of sulfidation. Sulfided sorbents were regenerated in N_2-air of H_2O-air mixtures at 600-700°C. Each sorbent was characterized (in terms of surface area and composition) before and after sulfidation. The performance of each sorbent in several cycles of sulfidation/regeneration was studied in terms of H_2S removal efficiency, absorptive capacity and regenerability. The characteristics of H_2S breakthrough curves were examined for each sorbent. Results are discussed.

43323 (CONF-850511—Absts., pp P1.12A-P1.12D) **Approach to biochemical fuel cell.** Phadke, R.S.; Sonawat, H.M.; Govil, G. (Tata Institute of Fundamental Research, Bombay (India)). 1985. NTIS, PC A14/MF A01. Order Number DE88008297/JAW.

From Fuel cell seminar; Tucson, AZ, USA (19 May 1985).

Biochemical Fuel Cells convert chemical energy of fuel molecules into electrical energy via enzyme catalyzed redox reactions. For example, Glucose + FAD-GOD + O_2 → Gluconic Acid + ($FADH_2$ - GOD) and $FADH_2$ - GOD → FAD + GOD + $2H^+$ + 2e where GOD is glucose oxidase. The major drawback of such a system lies in the slow electron transfer from the redox system to the electrodes. To overcome this they have immobilized FAD-GOD onto a carbon electrode. The methodology adopted is described. The effectiveness of immobilizing FAD and FAD - GOD was studied by cyclic voltammetry. The half-cell potential of GOD electrode was found to be 0.7 V.

43324 (CONF-850511—Absts., pp 10-13) **40-kW fuel cell power plant field test experience.** Grevstad, P.E.; Falcinelli, R. (United Technologies Corp., Windsor, CT (USA)). 1985. NTIS, PC A14/MF A01. Order Number DE88008297/JAW.

From Fuel cell seminar; Tucson, AZ, USA (19 May 1985).

The 40-kW fuel cell power plant was designed to meet an aggressive, commercial-level specification for efficiency, fuel composition, electrical output quality, noise, emissions, shipping, and installation. The field test power plant converts natural gas to 40-kW, three-phase, 60 Hertz electrical power at 40% efficiency. The power plant is provided to the utilities in two versions: a grid-independent configuration for utilities who want to evaluate the concept of fuel cells serving isolated loads independent of the electrical grid, and a grid-connected configuration allowing the fuel cell to operate in parallel with the electric utility grid. The power plant also provides up to 150,000 Btu per hour of heat in two forms: hot water at either 160°F or 275°F. At this writing, approximately 100,000 hours of operation have been accumulated by the fleet. Thus far, neither of the unique fuel cell components - the cell stack and fuel processor - have shown difficulties. However, the field testing is identifying design or component weaknesses in several ancillary components. The design of the high temperature heat recovery loop was not capable of dealing with water chemistries of all sites. The 1978-80 technology level used in the field test power plant showed deficiencies in the water recovery and treatment designs, necessitating unplanned water system flushing. Similar deficiencies also existed for some electronic control circuits. The use of threaded piping connections has proved a poor choice; many nuisance fluid leaks have had to be corrected. A team of engineers is charged with examining every problem which arises, whether site-related, design-related, or technology-related, to define features of future fuel cell power plants fully capable of meeting requirements of the commercial market place.

43325 (CONF-850511—Absts., pp 14-18) **40kW fuel cell installation experience and projections for commercial service.** Moard, D.M. (Southern California Gas Co., Los Angeles (USA)). 1985. NTIS, PC A14/MF A01. Order Number DE88008297/JAW.

From Fuel cell seminar; Tucson, AZ, USA (19 May 1985).

An important aspect to consider prior to deployment of fuel cells for onsite energy generation will be the installation requirements and their associated costs. The installation practices used by the participating utilities for the 40 kW test units have been documented during the program. This information was used to verify cost estimation techniques and assess the impact on installation requirements for an introductory onsite fuel cell. A total of 41 sites will be involved in the field testing of 46 power plants. A 200 kW unit is assumed here to be the size that will be offered for the first commercial units. In general, the following steps were required for installation of the 40 kW fuel cell: shipping and handling; site preparation: excavation and/or grading; architectural work: enclosure, building modification, foundation work, aesthetics; electrical: fuel cell to grid-connect unit, grid-connect to building and/or utility electrical system including any metering equipment; thermal interface of fuel cell to building heating system to include any metering equipment; gas service connection to fuel cell and any gas metering necessary; engineering design and managements; start-up and checkout; and permitting requirements. Actual installation cost averages for the first fifteen 40 kW fuel cells deployed in the program have been $1025/kW. An estimate of approximately $150/kW has been projected for a 200 kW installation if trained people using a standardized design concepts are used.

43326 (CONF-850511—Absts., pp 19-22) **Power quality and harmonics testing 40-kW onsite fuel cell grid connected power plants.** Houts, E.T.; Fortson, H.S. Jr.; Huddleston, J.D. III. (Georgia Power Co., Atlanta, GA (USA)). 1985. NTIS, PC A14/MF A01. Order Number DE88008297/JAW.

From Fuel cell seminar; Tucson, AZ, USA (19 May 1985).

With total voltage harmonic distortion measured at 2.4%, the inverter grid connecting unit (GCU) performance for the 40-kW onsite fuel cell power plant is well within the specification of +/- 5% total harmonic distortion published by the manufacturer, United Technologies Corporation. However, the specification does not address current distortion which appears to be enhanced and passed directly through the GCU to the utility grid. Excessive harmonic distortion can cause power transformers to heat up more quickly causing saturation of transformer core capacity, requiring larger transformers for a given load. Further, high fifth order harmonics can cause motors to run hotter and because of negative rotation characteristics can cause watthour meters to run slower. These findings illustrate electric system operation concerns of utilities regarding parallel connection to distributed power sources. It should be the role of utilities to cooperate and assist technically in the design of clean, efficient, and safe power conditioners for commercial fuel cell power plants.

43327 (CONF-850511—Absts., pp 23-24) **Site fuel cell market opportunity.** Knable, S.M. (Gas Research Institute, Chicago, IL (USA)). 1985. NTIS, PC A14/MF A01. Order Number DE88008297/JAW.

From Fuel cell seminar; Tucson, AZ, USA (19 May 1985).

This paper is an assessment of the US market opportunity for onsite fuel cells in the commercial, multifamily residential, and light industrial sectors. The purpose of this study is to provide insight into the size of the market for both the early market entry and mature phases of commercialization. In addition to identifying the magnitude of the market, a number of legal, regulatory, and business issues have been uncovered which directly impact the commercialization of onsite fuel cells. This paper focuses on the technical market factors which impact the opportunities for onsite fuel cells and discuss those issues which affect the commercial entry of power plants.

43328 (CONF-850511—Absts., pp 25-28) **Site phosphoric acid fuel cell technology development.** King, J.M.; Will, B.R. (United Technologies Corp., Windsor, CT (USA)). 1985. NTIS, PC A14/MF A01. Order Number DE88008297/JAW.

From Fuel cell seminar; Tucson, AZ, USA (19 May 1985).

The functional capability of fuel cell power plants is being demonstrated daily by over 40 power plants operated in an international field test program. The remaining technical challenge for the fuel cell is developing the technology basis for acceptable capital equipment cost and operating cost. This challenge is being addressed in development activity which includes effort for all the major and ancillary components of the fuel cell power plant. Cell stack improvements are demonstrated in short stacks of full area cells. The fuel processor cost reduction activity has been directed toward improved catalysts and simplified reformer design. The inverter has been simplified from the two-stage system used in the field test to a single-stage system. The ancillary components and system concepts being investigated in the technology program are aimed at alleviating or eliminating operating problems experienced in the field test activity. Fuel cell power plant designs treat electrical efficiency as a design variable. In a recent study, electrical efficiency exceeded 40% over load settings between 30 and 100% of rated load. This efficiency characteristic is especially attractive for power plants operating independent of the utility grid, which operate much of the time in the middle of this load range. Overall efficiency (electricity plus reject heat) is 89% at full load.

43329 (CONF-850511—Absts., pp 29-32) **Air cooled phosphoric acid fuel cell power plants.** Sakai, T.; Yamada, M.; Tajima, O.; Hagino, H.; Nishizawa, N. (Sanyo Electric Co., Ltd., Osaka (Japan)). 1985. NTIS, PC A14/MF A01. Order Number DE88008297/JAW.

From Fuel cell seminar; Tucson, AZ, USA (19 May 1985).

In 1984, Sanyo developed a second 50 kW phosphoric acid fuel cell (Type 2) composed of four cell stacks which are unified and arranged compactly inside a vessel, and also connected with a power conditioner. As a result, 50 kW phosphoric acid fuel cell power plant (type 2) has become a full system consisting of a fuel processor, a power section, the power conditioner and a control unit. This paper describes the system configuration, gives specifications, and discusses fuel cell stack construction, electrical connection, and the performance of the system.

43330 (CONF-850511—Absts., pp 33-34) **Engelhard phosphoric acid fuel cell program.** Kaufman, A. (Engelhard Corp., Edison, NJ (USA)). 1985. NTIS, PC A14/MF A01. Order Number DE88008297/JAW.

From Fuel cell seminar; Tucson, AZ, USA (19 May 1985).

The stack technology developed through the end of 1983 has been subjected to evaluation by the long-term testing of 4 kW stacks. These tests, employing 25-cell stacks of the 13 inch x 23 inch cell size, have been conducted using simulated reformate fuel. The longest-running stack in this series has surpassed 7000 hours of continuous operation on load. The current thrust of the technology development program is directed mainly toward stack cost reduction. Reductions in unit-area costs for stack components will be achieved mainly through minimizing the amount of graphite material used in bipolar plates and cooling plates. The main activity in the on-site cogeneration system development program is currently the testing and evaluation of a 25 kW stack module in an integrated system mode. The stack is fueled by reformate generated in a methanol processor. Provisions are being made at this site for utilization of the electrical and thermal outputs from the fuel cell system. The program to develop fuel cell power systems for electric forklift trucks involves continued evaluation of a 5 kW methanol-air experimental model that has been installed on a 4000-pound truck. In addition, prototype power system design work is being carried out; the key objectives of this effort are reduced size and lower system cost.

43331 (CONF-850511—Absts., pp 35-38) **Development of phosphoric acid fuel cell technology.** Usami, K.; Hamasaki, Y.; Matsuda, S.; Hirata, I.; Kishida, K. (Mitsubishi Electric Corp., Hyogo (Japan)). 1985. NTIS, PC A14/MF A01. Order Number DE88008297/JAW.

From Fuel cell seminar; Tucson, AZ, USA (19 May 1985).

During the past 4 years, the main emphasis has been placed upon improvement and optimization of the technologies and the system. With regard to the technology development, considerable efforts have been directed to studies on materials and processes such as catalyst dispersion, electrode treatment and manufacturing process. As a result, a new roller coating type electrode manufacturing process has been developed and the cell performance improvement of 100-110 mV at 200 mA/cm^2 has been achieved. The paper discusses cell component development, short stack performance testing, and tall stack fabrication of a 130 kW cell for installation in a petrochemical plant.

43332 (CONF-850511—Absts., pp 39-42) **Outline of evaluation test of 50 kW-5 at a PAFC power plant.** Takechi, T.; Nakayama, Y.; Sato, M. (Toshiba Corp., Tokyo (Japan)). 1985. NTIS, PC A14/MF A01. Order Number DE88008297/JAW.

From Fuel cell seminar; Tucson, AZ, USA (19 May 1985).

This report summarizes the efforts made for the development and evaluation of 50 kW PAFC experimental power plant which was operated to generate rated power successfully last year. The development of fuel cell stack and prototype steam reformer was started in 1980. To verify these technologies in system application, the experimental plant was fabricated at Hamakawasaki Works of Toshiba connected to its power line. the objectives of this development are to confirm system configuration, process control requirement and plant safety features to accumulate operating experiences and to refine computer model which will be used for system simulation of future plant by verification of those experimental results.

43333 (CONF-850511—Absts., pp 43-46) **Cell technologies for high pressure type PAFC.** Yoshioka, Y.; Tsutsumi, Y.; Mori, T. 1985. NTIS, PC A14/MF A01. Order Number DE88008297/JAW.

From Fuel cell seminar; Tucson, AZ, USA (19 May 1985).

In this program, Hitachi examined cell technologies for high pressure and high temperature type phosphoric acid fuel cells (PAFC). Topics investigated included the effect of catalyst on Pt dispersion methods and Pt sintering, SiC-metal phosphate composite matrix, ribbed carbon substrate and stack components such as separators. This report summarizes recent progress on these efforts.

43334 (CONF-850511—Absts., pp 47-51) **Electrochemical investigations in phosphoric acid at elevated temperatures and pressures.** McBreen, J. (Brookhaven National Lab., Upton, NY (USA)). 1985. NTIS, PC A14/MF A01. Order Number DE88008297/JAW.

From Fuel cell seminar; Tucson, AZ, USA (19 May 1985).

Much of the recent improvement in performance of phosphoric acid fuel cells has been due to fuel cell operation at elevated temperatures ($\approx$ 205°C) and pressures (8 atm). Apart from increased performance, pressurization minimizes electrolyte loss via vaporization and it significantly increases the volumetric power density as a result of decreases in conduit sizes, etc. Performance improvements accrue from an increase in the Nernst potentional, and decreases in the activation overvoltages at both electrodes. The activation kinetics for oxygen reduction in phosphoric acid displays anomalous behavior. The Tafel slope is constant ($\approx$ 120 mV/decade) in the temperature range 25-250°C. This would indicate that the transfer coefficient is proportional to the absolute temperature. The present work was carried out in an effort to gain an understanding of the electrochemistry of phosphoric acid and oxygen at elevated temperatures (230°C) and pressures (10 atmospheres of oxygen). Work included cyclic voltammetry studies on platinum in phosphoric acid and oxygen reduction studies on platinum rotating discs and on carbon supported platinum electrodes.

43335 (CONF-850511—Absts., pp 52-55) **Characterization of Westinghouse air-cooled fuel cell components.** Pebler, A. (Westinghouse Research & Development Center, Pittsburgh, PA (USA)). 1985. NTIS, PC A14/MF A01. Order Number DE88008297/JAW.

From Fuel cell seminar; Tucson, AZ, USA (19 May 1985).

The physical and chemical characterization of fuel cell materials and components is an important part of the Westinghouse phosphoric acid fuel cell development effort. Characterization enables quality control limits to be set on all materials, components and processes used in the manufacturing of fuel cells and, moreover, provides a correlation of fuel cell performance with the material characterization information and data. The performance of a gas diffusion electrode, for example is largely determined by the microstructure of the catalyst layer. Other important parameters and qualifications are the platinum particle size distribution, the extent of graphitization of the various carbon materials, the morphology of the backing paper, and the impurity content of the various materials. The characterization involves the starting materials used in the manufacture of the fuel cell components, as well as the components before and after testing in single or multiple cell stack assemblies. Many characterization techniques were evaluated and applied. Those found most productive include: transmission electron microscopy, X-ray diffraction, various spectrometric techniques, thermal analyses (TGA, DSC, Pyrolysis-MS), gas adsorption and chemisorption, and ion chromatography. Examples of the kind of information gathered from the fuel cell component examinations are given for: catalysts, carbon materials, and teflons.

43336 (CONF-850511—Absts., pp 56-59) **PAFC cathodes for utility applications.** Kush, A.K.; Christner, L.G.; Yeh, P.P. (Energy Research Corp., Danbury, CT (USA)). 1985. NTIS, PC A14/MF A01. Order Number DE88008297/JAW.

From Fuel cell seminar; Tucson, AZ, USA (19 May 1985).

Phosphoric Acid Fuel Cell (PAFC) cathodes for utility applications are required to provide a stable and high performance under pressurized conditions at relatively high current densities. Corrosion of carbon support and loss of platinum surface area are thought to be important factors affecting fuel cell cathode performance. Significant progress has been made in recent years in improving the performance of the cathode by the use of catalyst pretreatment, alloy catalysts, alternate carbon supports, structural changes and removal of impurities by bipolar plate heat treatment. Recent developmental efforts at Energy Research Corporation (ERC) have been directed at evaluating alternate corrosion-resistant carbon supports and alloy catalysts for better electrode performance and stability. Electrode optimization studies have also aided in improving the electrode manufacturing process. Results are discussed.

43337 (CONF-850511—Absts., pp 60-66) **Westinghouse PAFC technology performance improvement.** Rosey, R. (Westinghouse Electric Corp., Pittsburgh, PA (USA)). 1985. NTIS, PC A14/MF A01. Order Number DE88008297/JAW.

From Fuel cell seminar; Tucson, AZ, USA (19 May 1985).

The Westinghouse PAFC Utility Prototype Power Plant Program established performance goals and operating parameters for the fuel cell system. The fuel cell technology objectives defined to achieve these goals include an average beginning of use performance of 690 mV at 267 mA/cm^2, 190°C 4.7 Atm., 83% hydrogen utilization using reformed natural gas and 50% oxidant utilization using air, and endurance consistent with a voltage loss of 8 mV/1000 hours. This paper focuses on the major development efforts and alternate technology evaluations actively pursued to achieve the performance objectives. Specific components reviewed include: (a) heat treated platinum and alloy catalysts, (b) catalyst layers, (c) electrode supports and (d) acid transport/matrix layers. The methodology utilized to screen improvements include evaluation of performance and various material characterization tests. This paper focuses on the subscale cell performance evaluations at atmospheric test conditions of 200 mA/cm^2, 190°C, 80% fuel utilization (hydrogen) and 25% air utilization; available stack performance data also are provided for the pressurized test conditions.

43338 (CONF-850511—Absts., pp 67-70) **Outline of dispersed type 1MW PAFC demonstrator.** Itoh, N.; Nagashima, M.; Anahara, R.; Suzuki, K.; Kishida, K.; Matsuda, S. (New Energy Development Organization, Tokyo (Japan)). 1985. NTIS, PC A14/MF A01. Order Number DE88008297/JAW.

From Fuel cell seminar; Tucson, AZ, USA (19 May 1985).

Fuji Electric Co., Ltd., Fuji Electric Corporate Research and Development, Ltd. and Mitsubishi Electric Corporation are now promoting the construction work of 1MW phosphoric acid fuel cell power plant for dispersed generation under the contract of the New Energy Development Organization. The plant is scheduled to be completed by the end of FY 1985 in the area of The Kansai Electric Power Company Inc. near Osaka. This paper describes the system design and the units of fuel cells and inverters, lists the elemental techniques studied prior to construction, and discusses the construction schedule.

43339 (CONF-850511—Absts., pp 71-74) **Progress on the Westinghouse fuel cell power plant design.** Lance, J.R.; Saladna, E.F.; Wiseman, D.A.; Newby, D. (Westinghouse Electric Corp., Pittsburgh, PA (USA)). 1985. NTIS, PC A14/MF A01. Order Number DE88008297/JAW.

From Fuel cell seminar; Tucson, AZ, USA (19 May 1985).

Westinghouse Electric Corporation and Southern California Edison Company have entered into a phased agreement to design a 7.5 MWe DC air-cooled phosphoric acid fuel cell power plant scheduled for operation in 1989. This plant will be prototypical of the fuel cell power plants to be offered commercially by Westinghouse for all-electric and cogeneration applications. This paper discusses the progress to date of the Westinghouse/Southern California Edison prototype plant including discussions of the plant site layout, operational analyses, and design features which enhance performance and/or increase operating flexibility.

43340 (CONF-850511—Absts., pp 75-78) **Outline of 1 megawatt PAFC demonstrator: high temperature - high pressure type.** Ito, N.; Nagashima, M.; Hyuga, S.; Ono, S.; Akimaru, S.; Sakamoto, Y.; Masunaga, N.; Sato, M. (New Energy Development Organization, Tokyo (Japan)). 1985. NTIS, PC A14/MF A01. Order Number DE88008297/JAW.

From Fuel cell seminar; Tucson, AZ, USA (19 May 1985).

The 1 MW PAFC demonstrator that is classified as high temperature, high pressure type is being constructed by NEDO's fund at Chita 2nd thermal power stations, Chubu Electric Power Co. The objective of the demonstrator is to confirm the results of elemental developments for high temperature, high pressure type fuel cell and a reformer and at the same time, to prove feasibility of high efficient power generating system that aims to replace thermal power plants. Details of the following subsystems are given: (1) fuel cell stacks and cooling water: (2) fuel processing; (3) air processing; (4) power conditioning; and (5) control subsystem.

43341 (CONF-850511—Absts., pp 83-88) **High efficiency heat exchange reformer.** Stahl, H.; Rostrup-Nielsen, J.; Udengaard, N.R. (Haldor Topsoe A/S, Lyngby (Denmark)). 1985. NTIS, PC A14/MF A01. Order Number DE88008297/JAW.

From Fuel cell seminar; Tucson, AZ, USA (19 May 1985).

Steam reforming of hydrocarbons is an essential process for the manufacturing of hydrogen. Several features of this process make it particularly suitable as hydrogen source to a phosphoric acid fuel cell for electricity production. In the fuel cell technology steam is produced outside the reformer unit, and it is, therefore, of interest to design the steam reformer with minimum requirements to steam production without sacrificing the overall thermal efficiency. Such a reformer, the Heat Exchange Reformer, has been developed by Haldor Topsoe A/S. The principles of the Heat Exchange Reformer are described.

43342 (CONF-850511—Absts., pp 90-94) **Fuel cell power plant applications in the Virginia Power service territory.** Hirschenhofer, J.H.; Humes, J.L. (Gilbert/Commonwealth, Inc., Reading, PA (USA)). 1985. NTIS, PC A14/MF A01. Order Number DE88008297/JAW.

From Fuel cell seminar; Tucson, AZ, USA (19 May 1985).

In November 1981, Virginia Power Company (VP) initiated a major evaluation of conventional and alternative energy sources. Fuel cell technology was selected as one of the alternative power generation options to be studied. The objective of the ensuing Fuel Cell Study, performed by Gilbert/Commonwealth (G/C) for VP, paralleled the major study objective, to provide VP with technical and cost information needed to compare fuel cell power plants (FCPP) with both conventional and alternative power generation methods to make decisions regarding future expansion prior to the year 2000. This report is organized into the topical areas of: technology review, implementation strategy, power plant conceptual design and cogeneration aspects; it presents an overview of the VP Fuel Cell Study.

43343 (CONF-850511—Absts., pp 111-114) **Solid oxide fuel cells.** Fee, D.C.; Blackburn, P.E.; Busch, D.; Claar, T.D.; Dees, D.W.; Dusek, J.; Flandermeyer, B.; Fousek, R.; Kraft, T.E.; McPheeters, C.C.; Mrazek, F.C. (Argonne National Lab., IL (USA)). 1985. NTIS, PC A14/MF A01. Order Number DE88008297/JAW.

From Fuel cell seminar; Tucson, AZ, USA (19 May 1985).

A review is presented of the solid oxide fuel cell technology. The paper then describes the performance of the Westinghouse seal-less generator system including also a design description. The efficiency of this pressurized SOFC plant could be improved by the use of cell materials and designs presently under development. Such an improvement is the monolithic fuel cell being developed at Argonne National Laboratory. It has roughly 100 times the power density of conventional fuel cells. This technology is described.

43344 (CONF-850511—Absts., pp 115-118) **Zirconia fuel-cell power system.** Hsu, M.S. 1985. NTIS, PC A14/MF A01. Order Number DE88008297/JAW.

From Fuel cell seminar; Tucson, AZ, USA (19 May 1985).

For practical power plant applications, a zirconia fuel-cell system is required to have a reasonable volumetric power density for installation within confined spaces. A planar cell stack, which allows compact assembly, has been under development. The methods of fabrication and stack design, and the potential applications of such planar cell stacks have been established. Significant features are presented here.

43345 (CONF-850511—Absts., pp 119-122) **Novel electrode concepts for solid oxide fuel cells.** Linkous, C.A. (Brookhaven National Lab., Upton, NY (USA)). 1985. NTIS, PC A14/MF A01. Order Number DE88008297/JAW.

From Fuel cell seminar; Tucson, AZ, USA (19 May 1985).

With regard to electrode design, solid oxide fuel cell technology must deal with a constraint that is found in all other fuel cell technologies as well, namely, the need to maintain a tri-phase boundary between electrode, electrolyte, and gaseous fuel or oxidant. While in the case of liquid electrolytes one probably has no alternative but to use porous electrodes to maintain a triphase boundary, in the case of solid electrolytes, it may be possible to utilize alternative designs. This is due mainly to three characteristics of the solid electrolyte fuel cell: (1) the exchange current densities for H_2 oxidation and O_2 reduction are so prodigious at the operating temperature of 1000°C (on order of 100's of mA/cm² geometrical surface area) that tri-phase contact area can be sacrificed without limiting the cell; (2) pore volume can be expanded indefinitely without flooding, since the electrolyte is by definition solid; and (3) one can utilize electrode materials that are both electronically and ionically conductive. The result then is that it may be possible to expand electrode pore volume to the point where the concept of pore size gives way to a more macroscopic quantity, such as separation distance between adjacent grains, islands, or clusters of electrode material. This concept is discussed.

43346 (CONF-850511—Absts., pp 123-124) **Characterization of thin metal-oxide films using surface analytical techniques.** Schuler, A.M.; Strickland, G. (Brookhaven National Lab., Upton, NY (USA)). 1985. NTIS, PC A14/MF A01. Order Number DE88008297/JAW.

From Fuel cell seminar; Tucson, AZ, USA (19 May 1985).

One of the earliest candidate materials for the oxygen electrode in a high-temperature solid-oxide fuel cell, fabricated using thin-film technologies, was that of Sn-doped In_2O_3. This thin-film cathode material was deposited on a support tube of either calcia-stabilized zirconia, or aluminum oxide, by chemical vapor deposition (CVD) of In_2O_3 and SnO_2. It was reported that the films not only exhibited low resistivity, but a uniform reproducible thickness along a 25-cm length of the target tube. Due to the successful use of the CVD technique in the preparation of thin-film metal oxide materials, the authors decided to perform the initial fabrication experiments based on this method. Characterization of the CVD films was done using SEM and X-ray Photoelectron Spectroscopy (XPS). The structural information obtained, i.e., oxidation states of elements, catalytically active sites on the surface, and the presence of surface contaminants are discussed along with film surface morphology and thickness. The results will be used to more-fully understand the electrochemical reactions occurring at the fuel cell electrode.

43347 (CONF-850511—Absts., pp P2.1A-P2.1D) **Operational study of a phosphoric acid fuel cell with methanol/steam reforming.** Ratcliff, M.; Posey, F.L.; Johnson, D.K.; Chum, H.L. (Solar Energy Research Institute, Golden, CO (USA)). 1985. NTIS, PC A14/MF A01. Order Number DE88008297/JAW.

From Fuel cell seminar; Tucson, AZ, USA (19 May 1985).

This paper presents data on state-of-the-art phosphoric acid fuel cell s (from Energy Research Corporation, Danbury, CT) which have been modified in two ways. The first modification gave the cells in-situ steam reforming capabilities using a composite device which integrated the steam reformer with the anode current collector (SRCC). The second modification thermally integrated the reformer unit with the fuel cell. The authors have also simulated periodic failures of the steam reforming unit by directly injecting steam and methanol vapor into the fuel cells which were other-

wise continuously operated on pure hydrogen and air (or oxygen). Data concerning cell performance degradation and the nature of the organic products that can be condensed from the anode and cathode exhaust gases, as well as those remaining in the phosphoric acid matrix after methanol vapor addition, are reported. The details of the fuel cells used and the procedures for effluent analysis were reported recently.

43348 (CONF-850511—Absts., pp P2.2A-P2.2F) **Marine rated phosphoric acid fuel cell development.** Kumm, W.H. (Arctic Energies Ltd., Severna Park, MD (USA)). 1985. NTIS, PC A14/MF A01. Order Number DE88008297/JAW.

From Fuel cell seminar; Tucson, AZ, USA (19 May 1985).

The US Maritime Administration is sponsoring the development and at-sea demonstration of phosphoric acid fuel cells. Arctic Energies Ltd. (AEL) was awarded a Small Business Innovation Research (SBIR) Phase I contract in 1984 to design a marine rated container to house two different fuel cell power plant configurations, to provide auxiliary power for a training ship. The ship is the TS EMPIRE STATE operated by the Maritime College of the State University of New York (SUNY) at Fort Schuyler, Bronx, New York. The power level of the fuel cell power plants are each 30 kW. The ship will utilize the DC output at 240 volts directly into the auxiliary power bus. The 20 ft long standard marine rated container will house a dielectric liquid cooled fuel cell power plant in the forward half and an air cooled fuel cell power plant in the aft portion. Engelhard Corporation will supply the two 120 volt stacks plus a thermochemical fuel reformer for the dielectric liquid cooled fuel cell power plant. Energy Research Corporation will supply the two air cooled 120 volt stacks plus thermochemical fuel reformer for the aft section in the container. Fuel for the at-sea tests will be methanol, housed in a 5000 gallon standard marine rated chemical tank containers. Control and monitoring of the remotely operated fuel cell power plant will be performed from the ships auxiliary AC generation room.

43349 (CONF-850511—Absts., pp P2.3A-P2.3C) **Feasibility of very high temperature regenerative fuel cell systems for spacecraft energy storage.** Gross, S.; Murray, T. (Boeing Aerospace Co., Seattle, WA (USA)). 1985. NTIS, PC A14/MF A01. Order Number DE88008297/JAW.

From Fuel cell seminar; Tucson, AZ, USA (19 May 1985).

Regenerative fuel cell systems are important candidates for some future spacecraft applications. These systems produce electricity during spacecraft occultation in a conventional fuel cell mode by combining reactants, such as hydrogen and oxygen, in an efficient electrochemical process to generate electricity and the product water. During sunlight charging periods, the process is reversed to convert the water electrochemically to the initial reactant gaseous state. This regeneration mode can take place either in a separate electrolyzer unit, or in the fuel cell using bifunctional electrodes. Prior studies of alkaline and solid polymer electrolyte systems showed regenerative fuel cell systems have good potential for spacecraft applications. However, high temperature solid electrolyte systems have not previously been examined for spacecraft applications. This paper discusses the feasibility and reports results of a preliminary analysis of a high temperature solid electrolyte regenerative fuel cell system.

43350 (CONF-850511—Absts., pp P2.4A-P2.4C) **Catalysis in super acid electrolytes.** O'Grady, W.E.; Shea, C.E. (Brookhaven National Lab., Upton, NY (USA)). 1985. NTIS, PC A14/MF A01. Order Number DE88008297/JAW.

From Fuel cell seminar; Tucson, AZ, USA (19 May 1985).

The fluorinated organic sulfonic acids have a number of properties, including a very high oxygen reduction activity on platinum, which makes them attractive as potential fuel cell electrolytes. All of the perfluorosulfonic acids tested to date fall in the category of super acids. The authors have examined a number of new sulfonic acids including CF_3SO_3H, $CF_3(CF_2)_3SO_3H$, $CF_2(SO_3H)_2$, $(CF_2)_2(SO_3H)_2$, $(CF_2)_3(SO_3H)_2$, $(CF_2)_4(SO_3H)_2$ and $HN(SO_2CF_3)_2$. A number of properties of these acids have been examined including the conductivity, electrochemical stability, and some wetting characteristics. The oxygen reduction and the hydrogen oxidation activity on platinum have also been examined. This paper focuses on the oxygen reduction studies.

43351 (CONF-850511—Absts., pp P2.5A) **Testing an air-cooled 2.5 kW PAFC in Italy.** Ascoli, A.; Redaelli, G. (CISE S.p.A., Milano (Italy)). 1985. NTIS, PC A14/MF A01. Order Number DE88008297/JAW.

From Fuel cell seminar; Tucson, AZ, USA (19 May 1985).

An ERC-made phosphoric acid fuel cell stack, equipped with a methanol reformer and a dc-ac inverter, has been tested for two years in the laboratories of CISE S.p.A. The 80-cell stack totals 2.5 kW dc and a 2 kW ac output is currently obtained. Each cell is about 465 cm^2 in surface. This is the first kW-size fuel cell stack running in Italy. The stack was operated both on reforming gas and on simulated reforming gas. With both feedings the electrical characteristics v/sub s/ = f (I/sub c/) and the correaponding output power as a function of current intensity have been obtained. Chemical compositions of input gas mixture and of exhaust were analyzed by gas chromatography in several operating conditions. Partial voltages for groups of 5 cells, and the temperature in various positions inside the stack were also thoroughly mapped. DC overall electrical conversion efficiency ranges from about 15% at about half nominal power to about 22% at full power. The response of the stack to repeated load risers and drops from 20 to 100% and back is in the range of the second. The electrical efficiency of the stack was then measured at different operating temperatures, as a function of the fuel utilization factor. Open- and closed-circuit voltages were measured as functions of the operating temperature. Finally, the electrical characteristics v/sub s/ = f (I/sub c/) was measured again after one year operation, to detect performance variations. All data are synthetically presented, and a short outlook of potential applications of fuel cells in Italy is given.

43352 (CONF-850511—Absts., pp P2.6A-P2.6B) **Catalyst evaluation for methanol conversion for fuel cell applications.** Voecks, G.E. (California Institute of Technology, Pasadena (USA)). 1985. NTIS, PC A14/MF A01. Order Number DE88008297/JAW.

From Fuel cell seminar; Tucson, AZ, USA (19 May 1985).

The endothermic dissociation of neat methanol to hydrogen, without addition of steam has been considered for fuel cell applications. Choice of the proper catalyst to minimize side reactions, while enhancing dissociation and eliminating carbon is a critical issue. Furthermore, because of design and cost limitations placed on any reactor configuration, structural stability of the catalyst is mandatory. Heat transfer becomes a critical parameter, indicating the need for different catalyst systems than conventional packed beds. In this regard, various commercially available catalysts as well as novel catalyst configurations have been evaluated as to their activity and selectivity in methanol dissociation. Copper-based catalysts have been shown to be quite active, but stabilizers enhance undesirable side reactions to produce such hydrocarbons as dimethylether. The active copper species in the catalyst is not elemental copper and will, when subjected to temperatures above 300°C in the presence of methanol vapor and products, be reduced to the inactive elemental state. This phenomenon has been related to loss in catalyst structural integrity as well. Results from various catalysts, including highly active metal supported catalysts, are compared with respect to their activity and selectivity. A metal supported copper catalyst has been shown to be an order of magnitude more active than a comparable pellet catalyst. No carbon deposition was observed on the catalyst.

43353 (CONF-850511—Absts., pp P2.7A-P2.7E) **Applications of enhanced-heat transfer catalyst supports to steam reforming for phosphoric acid fuel cells.** Flytzani-Stephanopoulos, M.; Voecks, G.E. (California Institute of Technology, Pasadena (USA)). 1985. NTIS, PC A14/MF A01. Order Number DE88008297/JAW.

From Fuel cell seminar; Tucson, AZ, USA (19 May 1985).

In order to delineate the heat transfer characteristics pertaining to each catalyst bed configuration (pellet or monolith), recent experimental and modeling work at JPL has focused on comparative heat transfer studies of metal monoliths and pellets in the absence of chemical reaction, but under conditions typical of externally-heated, non-adiabatic steam reformers. Two important conclu-

sions have, thus, resulted from this work. (a) Honeycomb metal monoliths can be used to retrofit existing steam reformers (or heat exchangers) by replacing a certain length of pellets at the most energy-demanding location within the bed (e.g., top one-fourth to one-third of steam reformers). This will result in higher energy efficiency because of reduced external heating requirements. (b) Novel monolithic configurations, allowing for radial gas mixing, may be expected to combine the heat transfer features of both the honeycomb monolith and the pellet bed geometries, i.e., heat conduction and convection, respectively.

43354 (CONF-850511—Absts., pp P2.8A-P2.8D) **Computer analysis of integrated neat methanol fuel processing techniques.** DuBois, T.G.; Tyler, R.W.; Taschek, W.G. (Army Belvoir Research and Development Center, Fort Belvoir, VA (USA)). 1985. NTIS, PC A14/MF A01. Order Number DE88008297/JAW.

From Fuel cell seminar; Tucson, AZ, USA (19 May 1985).

Three systems configurations were analyzed to determined their operational characteristics. Each of these configurations were based on a 5 kW phosphoric acid fuel cell power plant which uses a catalytic partial oxidizer/shift reactor for fuel processing. Each configuration is shown schematically. The design criteria for the analysis was to determine the operating conditions which yield the minimum stack size and minimum fuel consumption for a particular power plant configuration. The stack hydrogen utilization and oxygen utilization, and the oxygen to carbon ratio entering the fuel processor were the three independent operating conditions that were varied to determine the best design points. In performing the analysis, three system constraints were imposed on the analytical model. The first constraint set the limits on the stack oxygen utilization between 40 and 65%. The second constraint held the hydrogen stack exit concentration to no less than 10%. The third constraint fixed the maximum allowable carbon monoxide stack exit concentration to 5%. These parameters form an envelope of cell stack operation which conforms to reasonable stack operating conditions. Results and recommendations are discussed.

43355 (CONF-850511—Absts., pp P2.9A-P2.9D) **Research in catalytic fuel processing techniques.** Adams, A.A.; Coleman, A.J.; Joyce, L.S.; Nagel, K.E. (Army Belvoir Research and Development Center, Fort Belvoir, VA (USA)). 1985. NTIS, PC A14/MF A01. Order Number DE88008297/JAW.

From Fuel cell seminar; Tucson, AZ, USA (19 May 1985).

One phase of the Army's fuel cell research program is to examine techniques to produce hydrogen from liquid fuels. The main projects in this effort are (1) investigating partial oxidation/reforming techniques for the processing of neat methanol, (2) investigating the performance of catalysts for steam reforming of impure methanol, and (3) characterizing and measuring activities and selectivities of potential catalysts for hydrocarbon reforming. This report reviews these projects, both in-house and contractual, describing current investigations on methanol systems and introducing projects to evaluate advanced concepts for reforming heavy hydrocarbon fuels.

43356 (CONF-850511—Absts., pp P2.10A-P2.10D) **Competition between fuel cells and other cogeneration devices and customer intentions for fuel cell adoption.** Meyer, W.; Shangraw, R.; Brolin, M.; Bretschneider, S.; Wilemon, D. (Syracuse Univ. Institute for Energy Research, NY (USA)). 1985. NTIS, PC A14/MF A01. Order Number DE88008297/JAW.

From Fuel cell seminar; Tucson, AZ, USA (19 May 1985).

A two year long study of the potential market impact of onsite fuel cells delivering between 40 and 2000 kW (e) has recently been completed. During this study, the potential market competition between fuel cells and other cogeneration devices was evaluated and the adoption intention of utility customers who would economically benefit from fuel cell purchase was surveyed. There are a number of devices that compete with the low temperature fuel cell in the general category of cogeneration devices. Included in the analysis performed during this study were: steam turbine topping cycles; open cycle combustion turbine topping cycles; closed cycle combustion turbine topping cycles; combined cycle systems; diesel topping systems; rankine bottoming cycles; and stirling engines.

43357 (CONF-850511—Absts., pp P2.11A-P2.11G) **Partial oxidation reformer for small fuel cell power plants.** Christner, L.G.; Patel, D.N.; Ghezel-Ayagh, H.G. (Energy Research Corp., Danbury, CT (USA)). 1985. NTIS, PC A14/MF A01. Order Number DE88008297/JAW.

From Fuel cell seminar; Tucson, AZ, USA (19 May 1985).

Small phosphoric acid fuel cell power plants have used a mixture of methanol and water as the fuel for steam reforming. It is desirable to eliminate the need for this mixture or an external supply of water. Using the exhaust gas from the fuel cell cathode and or anode can provide oxygen for partial oxidation and water for steam reforming. The catalyst chosen for partial oxidation (a platinum black stainless steel monolith) was extremely effective at room temperature. A methanol/air mixture ignited easily at room temperature and sustained the reaction when switched to simulated cathode exhaust. During this reaction the oxygen is totally consumed and some steam reforming takes place. The reaction was so rapid that reactor geometry was more important than the kinetics. This platinum catalyst also accelerated a dehydration reaction which produced dimethylether at temperatures about 350°F. Dimethylether, however, is steam reformed over the usual steam reforming copper catalyst. A bed of the copper catalyst was used in series with the platinum catalyst to complete the reforming and shift reactions. Results from these development studies are discussed.

43358 (CONF-850511—Absts., pp P2.13A-P2.13B) **System design and economic evaluation of an H_2-air phosphoric acid fuel cell power plant for all electric and cogeneration applications.** Malloy, J.R. Jr. (Massachusetts Institute of Technology, Cambridge (USA)). 1985. NTIS, PC A14/MF A01. Order Number DE88008297/JAW.

From Fuel cell seminar; Tucson, AZ, USA (19 May 1985).

This paper discusses the Phosphoric Acid Fuel Cell Power Plant (PAFCPP) systems study sponsored by the Integrated Energy Systems (IES) consortium, Laboratory for Electromagnetic and Electronic Systems at the Massachusetts Institute of Technology. The objectives of the study are: to develop preliminary plant designs, to determine optimum operating conditions, estimate capital and operating costs, and calculate economic performance for a by-product hydrogen fueled PAFCPP. There are four areas of application that a by-product hydrogen fueled PAFCPP could operate in. These are: utility - all electric; industry - all electric; utility - cogeneration; and industry - cogeneration. In order to evaluate these four areas of application, a fuel cell systems model was developed. This model determines the cycle design, technical performance, capital and operating costs and the economic performance for various design and operating conditions. The stack model is based on the United Technologies Corporation FCG-1 cell stack. However, the cycle has been modified to optimize both system efficiency and economics.

43359 (CONF-850511—Absts., pp 125-128) **Technology and applications of ELENCO's alkaline fuel cells.** van den Broeck, H. (ELENCO N.V., Mol (Belgium)). 1985. NTIS, PC A14/MF A01. Order Number DE88008297/JAW.

From Fuel cell seminar; Tucson, AZ, USA (19 May 1985).

In terms of basic manufacturing techniques for electrodes and stacks, as well as performance levels, ELENCO has reached the targets it set forward when starting its program in 1976. A short review is presented on: (a) electrode manufacturing; (b) stack manufacturing; (c) performance levels achieved; (d) operating experience; and (e) further development. The application areas which are most attractive for alkaline fuel cells are: (a) electric vehicles; (b) defense applications; (c) stationary power groups; and (d) chemical industry. These are briefly described.

43360 (CONF-850511—Absts., pp 129-130) **20-kW indirect methanol phosphoric acid fuel cell system test.** Murray, H.S. (Los Alamos National Lab., NM (USA)). 1985. NTIS, PC A14/MF A01. Order Number DE88008297/JAW.

From Fuel cell seminar; Tucson, AZ, USA (19 May 1985).

Results are given for the testing of a state-of-the-art phosphoric acid fuel cell using decomposed methanol as a fuel. The objective of the tests was to establish a baseline of performance for future comparisons in the development of fuel cell systems for

transportation applications. The fuel cell stack is made up of 200 cells. The bipolar plates are 12 in. by 17 in. with an active area of 1.06 ft^2. Separate cooling channel plates are provided in every fifth cell for cooling air flowing normal to reactant flow channels. Cooling air flow is delivered via a 2 hp DC motor-driven centrifugal fan. The fuel cell was designed to provide 21 kW gross electrical power with a 31 kW peak capability at sea level, using reformate as fuel.

43361 (CONF-850511—Absts., pp 131-137) **On-board fuel processing for electric vehicles.** Springer, T.E.; Murray, H.S.; Vanderborgh, N.E. (Los Alamos National Lab., NM (USA)). 1985. NTIS, PC A14/MF A01. Order Number DE88008297/JAW.

From Fuel cell seminar; Tucson, AZ, USA (19 May 1985).

Methanol-fueled electric vehicles most likely would be propelled using acid fuel cell-motor units driven by hydrogen, derived from methanol, and air, perhaps using a hybrid configuration. Consequently on-board conversion of liquid methanol to hydrogen is a necessary processing step of the fuel cell-based power plant. Vehicular designs place strict requirements on power systems for considerations of weight, volume, safety, start-up time and load transients are important as are the usual concerns in fuel cell plants for cost, efficiency and emissions. Fuel processing of methanol to hydrogen can proceed either through a cracking (to form CO and H_2)-shift (to react CO with steam) combined process or through steam reforming (to produce directly H_2 and CO_2). These fuel processing reactions are sharply endothermic and are prompted on any of a series of heterogeneous catalytic surfaces. The fuel cell stack, due to both inefficiencies in the conversion of chemical to electrical energy, and to unutilized hydrogen that vents from the anode compartment, produces heat. Efficient system designs dictate that thermal energy exhausted from the stack, power the fuel processing section. This proposed vehicular application sets requirements for rapid load transients, both during the startup sequence, and during operation. Continuous fuel quality is another design criteria since excessive CO production is known to degrade anode performance. These design criteria are quite distinct from previous methanol-to-hydrogen production systems. This paper describes design criteria that are now under consideration to meet these goals.

43362 (CONF-850511—Absts., pp 138) **Alkaline fuel cells for aerospace application.** Stedman, J.K. (United Technologies Corp., Windsor, CT (USA)). 1985. NTIS, PC A14/MF A01. Order Number DE88008297/JAW.

From Fuel cell seminar; Tucson, AZ, USA (19 May 1985).

In NASA's space program, United Technologies alkaline electrolyte fuel cells operating on pure hydrogen and oxygen reactants have provided electrical power for housekeeping and life support in both the Apollo Command Module and in the current Space Shuttle Orbiter Vehicle. The use of this light-weight, highly efficient fuel cell technology is projected to expand over the next decade as NASA establishes a permanent presence in space through the Space Station Program and the Department of Defense conducts research towards an active space-based ballistic missile defense. This briefing describes United's alkaline fuel cell technology and its application to the missions mentioned above. The results of a NASA sponsored technology program and preliminary system design of a regenerative fuel cell energy storage system for the Space Station Program are described. This system concept offers many operational and performance advantages over the conventional nickel cadmium batteries currently used in space satellites. The Air Force is considering the fuel cell as a candidate for prime power in high power-short duration missions as well as for energy storage in higher power mid and geosynchronous altitude satellites. A current study funded by the Air Force Aeropropulsion Lab is defining potential capabilities and benefits of fuel cells in these Air Force applications. These results are summarized.

43363 (CONF-850511—Absts., pp 139-144) **Small methanol fuel cell power plants.** Abens, S.; Farooque, M. (Energy Research Corp., Danbury, CT (USA)). 1985. NTIS, PC A14/MF A01. Order Number DE88008297/JAW.

From Fuel cell seminar; Tucson, AZ, USA (19 May 1985).

Energy Research Corporation has developed fully automatic transportable phosphoric acid fuel cell power plants for the US Army for field use and a stationary power plant for the US Air Force for baseload applications. Methanol, steam reformed to hydrogen and carbon dioxide is used as power plant fuel. Currently, methanol is envisioned as the best candidate to displace petroleum fuel. Also important, commercial grade methanol can be used directly in the fuel cell power plant without pretreatment or purification. Last year ERC delivered two 3 kW power plants to the US Army Ft. Belvoir R & D Center (Ft. Belvoir, VA) for evaluation. These power plants are capable of delivering either regulated DC or AC electrical power through the use of interchangeable power conditioners. The ERC 5 kW power plant intended for the US Air Force for baseloaded stationary applications is a modified design version of the Army 3 kW power plant. Operating characteristics and performance of both systems are described.

43364 (CONF-850511—Absts., pp 145-148) **Regenerative fuel cells: NASA's energy storage option for the Space Station.** Hoberecht, M.A.; Sheibley, D.W. (NASA Lewis Research Center, Cleveland, OH (USA)). 1985. NTIS, PC A14/MF A01. Order Number DE88008297/JAW.

From Fuel cell seminar; Tucson, AZ, USA (19 May 1985).

One of the leading energy storage candidate technologies for Space Station is the regenerative fuel cell (RFC) system which is the only option selected by NASA for their Space Station Advanced Development Program. The RFC system has been under development since 1979, when OAST initiated a program to bring the integration of both fuel cell and electrolysis technology to a level of flight readiness by 1987. This paper describes the alkaline and solid polymer electrolyte technology options, gives a comparison of energy storage systems, and discusses key RFC design features.

43365 (CONF-850511—Absts., pp 149-152) **High efficiency direct fuel cell systems for dispersed generation.** Snyder, W.G.; Monn, M.G.; Patel, P.S.; Tawari, T.D.; Baker, B.S. (Fluor Technology Inc., Irvine, CA (USA)). 1985. NTIS, PC A14/MF A01. Order Number DE88008297/JAW.

From Fuel cell seminar; Tucson, AZ, USA (19 May 1985).

A study was conducted for the Electric Power Research Institute (EPRI) to refine development targets for 2 MW internal reforming molten carbonate fuel cell (IR-MCFC) systems. The IR-MCFC system utilizes hydrocarbon fuels, such as methane, directly in the fuel cell, thus eliminating most of the external fuel processing equipment and other support systems required by conventional fuel cell systems. The initial study established a simple, environmentally-benign, power plant design capable of a low heat rate (6500 Btu/kWh) at a capital cost of about $1200/kW for a complete power plant. It is anticipated that such a simplified dispersed generator system will have potential applications for utility, institutional, and light commercial or industrial power supply systems. Advantages over conventional power generators include high efficiency, extremely low emission levels, and potential for cogeneration. The objective of the extension study was to refine the development targets established in the previous work. This objective was met in two steps. Parametric studies of fuel cell stack design and operating parameters were performed. Changes to the power plant process configuration were then studied in order to enrich the fuel and oxidant streams and to relax fuel cell technology development constraints. The starting point for these activities was the baseline system design established in the previous work. The busbar cost of electricity was used as the determinant in assessing the impact of various changes to design parameters and to the system configuration. The combined results from these two steps suggest boundaries for the development of the IR-MCFC system.

43366 (CONF-850511—Absts., pp 153-156) **Status of molten carbonate fuel cell development at Hitachi, Ltd.** Takeuchi, M.; Tamura, K.; Hishinuma, Y.; Sohma, S. (Hitachi, Ltd., (Japan)). 1985. NTIS, PC A14/MF A01. Order Number DE88008297/JAW.

From Fuel cell seminar; Tucson, AZ, USA (19 May 1985).

This paper briefly describes component development for molten carbonate fuel cells. Results of testing cathodes, anodes, and electrolyte plates are discussed. A 1-kW fuel cell stack has been fabricated and tested. Results are given. The next step is development of a 10-kW fuel cell stack.

43367 (CONF-850511—Absts., pp 157) **Model for the fluxing of oxides in molten carbonate fuel cells.** Shores, D.A. (Univ. of Minnesota, Minneapolis (USA)). 1985. NTIS, PC A14/MF A01. Order Number DE88008297/JAW.

From Fuel cell seminar; Tucson, AZ, USA (19 May 1985).

The degradation of NiO cathodes in molten carbonate fuel cells occurs by fluxing, i.e., dissolution, transport and precipitation of metal or oxide in the electrolyte. To reduce the rate of degradation several new materials, including ternary oxides, are being considered for cathodes. This paper considers the fluxing of these materials. The fluxing process involves both thermodynamic and kinetic issues. The dissolution of an oxide occurs via acidic or basic reactions. In general, several such reactions may be hypothesized for a particular oxide, but not all of them may be realized experimentally. For simple binary oxides (A/sub x/O) the fundamental thermodynamic parameters controlling solubility are salt composition, P/sub CO_2/ and P/sub O_2/. The measurement of solubilities as a function of these parameters is a useful way of identifying actual dissolution reactions. The solubility of NiO has been carefully measured as a function of P/sub O_2/ and P/sub CO_2/ in several molten carbonates, and these results have revealed moderately complex dissolution behavior. The dissolution of ternary oxides (AB/sub x/O/sub y/) involves an additional experimental parameter: the activity of the component oxides. This leads to additional dissolution reactions and corresponding soluble species. Each species will be stable over a range of P/sub O_2/ and P/sub CO_2/. However, because the various species generally will have differing ranges of stabilities, one may expect several zones of species predominance on a plot of solubility vs basicity. This can lead to selective dissolution, where one component oxide will be preferentially dissolved. This behavior is illustrated with a model system.

43368 (CONF-850511—Absts., pp 162-165) **Development status of Toshiba advanced paste electrolyte molten carbonate fuel cells.** Shirogami, T.; Murata, K.; Sakamoto, K. (Toshiba R & D Center, Kawasaki (Japan)). 1985. NTIS, PC A14/MF A01. Order Number DE88008297/JAW.

From Fuel cell seminar; Tucson, AZ, USA (19 May 1985).

Toshiba has developed a soft pressing method of fabricating electrolyte plates which is used for manufacturing a large cell up to 10 ft^2. After being blended and kneaded, the mixture of fine powders of alkaline carbonate, such as, Li_2CO_3 and K_2CO_3, electrolyte supporting material such as $LiAlO_2$, crack arresting $LiAlO_2$ short fibers and a small amount of some organic binder is spread over a mold disk and pressed 100 kg/cm^2 at moderate temperature to form plates and sheets. Although, the electrolyte layer is rather poor in density, with the use of the dual porosity electrodes which work as bubble pressure barriers preventing cross flow of the reacting gases, it can be made a high performance cell. Many laboratory cells (reacting area about 140 cm^2) and bench scale cells (600 cm^2) have been assembled and evaluated. Some of them have been tested over 1000 hours successfully without any electrolyte additions.

43369 (CONF-850511—Absts., pp 170-171) **Status of molten carbonate fuel cells at United Technologies Corporation.** Meyer, A.P.; Reiser, C.A. (United Technologies Corp., Windsor, CT (USA)). 1985. NTIS, PC A14/MF A01. Order Number DE88008297/JAW.

From Fuel cell seminar; Tucson, AZ, USA (19 May 1985).

Recently, United completed a 5000-hour molten carbonate fuel cell stack test. The test was conducted at a scale and under conditions which make the results a relevant basis for an estimate of power plant capability. The stack consisted of 20 1-ft^2 cells with a total output rating of 2.3 kW. It was large enough to be thermally self-sustaining, i.e., it could be operated and insulated as it would be in a power plant. The number of cells was sufficiently great to produce all the effects of real fluid and thermal distributions. Therefore, the performance and degradation observed is not an ideal laboratory result but is a measure of what can be achieved in a power plant. Similarly to again reflect what can be achieved in a practical power plant each of the components of the stack was fabricated using methods now used in commercial manufacturing operations. The configuration of the parts were also all directly scalable without redevelopment for use in stacks with ratings of 10's of kilowatts to megawatts. The test was conducted over simulated power plant load profiles using gases representative of on-site, dispersed and coal-central station applications. Stack performance remained stable and above the level required for a practical power plant throughout the entire test. The results of the stack test corroborates the power plant endurance capability United projects for cells of this design to at least 50,000 hours.

43370 (CONF-850511—Absts., pp 172) **Inhibition of sintering and creep in copper and nickel.** Ness, E.A.; Johnson, D.L.; Chandy, R.R. (Northwestern Univ., Evanston, IL (USA)). 1985. NTIS, PC A14/MF A01. Order Number DE88008297/JAW.

From Fuel cell seminar; Tucson, AZ, USA (19 May 1985).

Potential anode materials for the molten carbonate fuel cell are nickel and copper. The high surface area required for efficient cell operation also acts as a driving force for densification of these materials. At the operating temperature of 650°C, high surface area compacts of the pure metals sinter at unacceptably high rates. The application of a static load increases the densification rate through creep. The natural tendency of these materials to sinter and creep may be inhibited by the addition of a dispersed oxide. This has been done with aluminum oxide additions. Compacts were pressed and heated to various temperatures under static loads while monitoring the shrinkage with a dilatometer. Shrinkage as little as 2% at temperatures as high as 965°C have been observed over 400 minutes in compacts with a 1 wt.% addition of alumina. To understand the mechanism by which tense oxide particles inhibit the sintering, an estimate of the activation energy has been determined in compacts with a 0.1 wt.% addition of alumina by measuring the shrinkage rate before and after a temperature change. In the case of copper, the activation energy appears to be higher than that of volume diffusion. This suggests that the normal diffusional paths were interrupted, and that a different mechanism is responsible for the observed shrinkage. Due to the manner in which the alumina was applied, the oxide particles sit only on the surfaces of, and in the grain boundary between, particles. Such positioning would not necessarily inhibit volume diffusion (to yield a higher activation energy) since no oxide is present in the volume of the copper particles. The implication is that processes at the oxide-copper interface are rate limiting.

43371 (CONF-850511—Absts., pp 182-185) **Onsite industrial applications for natural gas-fueled fuel cells.** Hooie, D.T.; Camara, E.H. (Gas Research Institute, Chicago, IL (USA)). 1985. NTIS, PC A14/MF A01. Order Number DE88008297/JAW.

From Fuel cell seminar; Tucson, AZ, USA (19 May 1985).

By the 1990's three types of fuel cells are expected to be available. These are phosphoric acid, carbonate, and solid oxide. The cogeneration market offers a great opportunity for commercial introduction of these three fuel cell technologies, as each one can provide power and waste heat to a different sector of this market. The paper presents a summary of the status of the technology for each of these three main fuel cell types and comments on their applicability to the industrial cogeneration sector.

43372 (CONF-850511—Absts., pp 186-189) **Fuji's alkaline fuel cell technologies.** Koseki, K.; Kobayashi, T.; Tsuji, Y. (Fuji Electric Corporate Research and Development Ltd., Yokosuka (Japan)). 1985. NTIS, PC A14/MF A01. Order Number DE88008297/JAW.

From Fuel cell seminar; Tucson, AZ, USA (19 May 1985).

Fuji Electric has been working on the development of alkaline hydrogen-air and hydrogen oxygen fuel cells since 1961. This paper describes a 1-kW hydrogen-air stack and a 7.5-kW hydrogen-oxygen stack. Cell performance and applications are also discussed. The use by industries with a hydrogen by-product and for emergency power supplies is mentioned.

43373 (CONF-850511—Absts., pp 190-193) **Potential of fuel cells in the chlor-alkali industry.** Altseimer, J.H.; Roach, F.; Mangeng, C.A.; Anderson, J.M. (Los Alamos National Lab., NM (USA)). 1985. NTIS, PC A14/MF A01. Order Number DE88008297/JAW.

From Fuel cell seminar; Tucson, AZ, USA (19 May 1985).

This paper discusses the technical, economic, and market potential of fuel cells in a cogeneration configuration in the chlor-alkali industry. Three candidate fuel cell systems were considered:

phosphoric acid; alkaline; and molten carbonate. Two conventional energy systems were also considered: gas turbine combined cycle and utility power plus boiler steam. The paper lists the characteristics of the chlor-alkali industry, describes the study approach, and discusses results.

43374 (CONF-850511—Absts., pp 194-197) **Application of fuel cells to chlorine-caustic technology.** Gelb, A.; Garman, A.; Bloomfield, D.; Piperopoulou, H. (Physical Sciences Inc., Andover, MA (USA)). 1985. NTIS, PC A14/MF A01. Order Number DE88008297/JAW.

From Fuel cell seminar; Tucson, AZ, USA (19 May 1985).

The results of a systems analysis investigation of the application of fuel cell technology to the chlorine-caustic electrolytic industry are presented. An energy and economic analysis of five systems has been performed: (1) conventional diaphragm cell technology, (2) conventional diaphragm cell technology incorporating phosphoric acid fuel cells, (3) conventional membrane cell technology, (4) membrane cell technology incorporating phosphoric acid fuel cells, and (5) a coupled membrane cell with alkaline fuel cell system (PSI system). The energy consumption analysis shows that the PSI system is capable of plant energy consumption reductions of over 50% compared to conventional diaphragm cell technology and about 30% compared to current membrane cell technology. The use of phosphoric acid fuel cells results in smaller but significant energy savings, 3% and 6%, for diaphragm and membrane cell technologies, respectively. Economic analysis of the cost benefits of implementing the PSI system indicates expected after-tax returns on investment of between 30 to 50%. Predicted return on investment for phosphoric fuel cell technology is higher than for the alkaline fuel cell system. However, the installation of the PSI system results in much higher predicted profits.

43375 (CONF-850511—Absts., pp 198-199) **Commercialization of an 11-MW fuel cell power plant.** Handley, L.M.; Cannon, C.A. (United Technologies Corp., Windsor, CT (USA)). 1985. NTIS, PC A14/MF A01. Order Number DE88008297/JAW.

From Fuel cell seminar; Tucson, AZ, USA (19 May 1985).

Recognizing the special value of the fuel cell in electric utility systems, United Technologies and Toshiba Corporation have recently agreed to combine their efforts to expedite the commercial use of fuel cells and related equipment and technology. During the next two years, a major activity of the new company will be design, development, and marketing of a nominal 11-megawatt fuel cell power plant for electric utility use. The power plant is being designed to operate on both natural gas and liquid hydrocarbon fuel, and to have a nominal heat rate of 8300 Btu/kWh. It will also be optionally convertible to operate on methanol fuel and to recover waste heat for cogeneration. Much of the equipment will consist of factory-assembled, truck-transportable modules arranged in a standard configuration at the site to minimize installation costs.

43376 (CONF-850511—Absts., pp 201-202) **Solid oxide fuel cell power plants: the new perspective for commercialization.** Wiener, G.W.; Brown, J.T. (Westinghouse Research and Development Center, Pittsburgh, PA (USA)). 1985. NTIS, PC A14/MF A01. Order Number DE88008297/JAW.

From Fuel cell seminar; Tucson, AZ, USA (19 May 1985).

During the past 12 months, a complete assessment of the state of solid oxide fuel cell technology has been carried out at the Westinghouse Electric Corporation. In parallel with the technical assessment a strategy for market development was also undertaken. As a result of these studies, it has been concluded that a product can be available for commercial introduction as early as 1990. This time frame suggests that the solid oxide fuel cell will compete for market share with other fuel cell technologies now being pursued around the world. The distinguishing characteristics of the solid oxide fuel cell are numerous as compared to other fuel cell technologies. These are described.

43377 (PB—88-210356/XAB) **Development of planar-geometry solid-oxide fuel-cell technology. Phase 1 final report, July 1, 1986-July 31, 1987.** Khandkar, A.C.; Prouse, D.W. (Ceramatec, Inc., Salt Lake City, UT (USA)). Jul 1987. 97p. (PROG—87015308). NTIS, PC A05/MF A01.

This report documents the developmental effort on fabrication of a planar-geometry solid-oxide fuel cell. The main thrust of the Phase I effort was to develop fabrication technology to produce planar-geometry SOFCs. Ceramatec has successfully developed and demonstrated thin, flat, and gas-impermeable electrolyte membranes of 2 1/4 inches x 2 1/4 inches square planar area x 0.002 to 0.005 inches in thickness. The flatness achieved on these electrolyte membranes allowed development of screen-printing techniques for depositing the anode and cathode layers. Ceramic-block manifolds were fabricated for manifolding the single-cell subassemblies. Single cell SOFC tests were conducted at IFC. The measured OCVs were found to agree well with the theoretical OCV's for H_2/O_2, H_2/air, CH_4/O_2 and CH_4/air as the fuel gas/oxidant gas reactants, respectively. A Phase II program to resolve critical developmental issues, optimize single cell performance and test a multi-cell stack was evolved.

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REFER ALSO TO CITATION(S) 43463

3201 Buildings

REFER ALSO TO CITATION(S) 42937, 42942, 43301, 43453

43378 **(A7—111985) Retrofit curtain for overhead doors. Phase 1 report: review of proposed technology.** Leckie, R.E. (Appropriate Technology, Calgary, Alberta (Canada)). Nov 1985. 30p. (CE—01650). CANMET/TID, Energy, mines and Resources Canada, 555 Booth St., Ottawa, Ont., Canada K1A 0G1; $0.34CAN per page, $3.40 CAN minimum.

The purpose of this project was to develop and test a curtain for reducing heat loss through existing overhead doors. This report contains the results of a review of related technology and research, an evaluation of the proposed technology and identification of a test facility in Alberta. A survey of existing technology revealed one product similar in concept to the retrofit curtain. The application of this product is restricted to metal rolling doors and it has a cumbersone deployment mechanism. Weatherstripping the perimeter of a door can reduce the air leakage by 50%. However, it does not reduce air leakage through the door panels nor does it increase the thermal resistance of the door. According to another survey approximately 70% of existing shipping doors in Ontario are of the type that can be economically retrofitted with the insulating curtain (i.e. sectional overhead and rolling doors without weatherstripping or insulation). No detailed survey has been done on the types and condition of shipping doors in Alberta. However, several door installers in Calgary indicated that sectional and overhead doors are also the most common types of doors in Alberta. It is estimated that the curtain will save enough energy to pay for itself in fewer than 3 years. The thermal performance and basic design of the curtain has been proven in previous tests. No insurmountable technical problems are anticipated in developing the curtain as a retrofit technique for shipping doors. 4 refs., 6 figs., 8 tabs.

43379 **(AERE-G—4079-Vol.3) Study of absorption cycle heat pump based heating units and their potential in the UK domestic central heating market. Volume 3: working fluids.** Harvey, J.; Finney, G.W.; Colyer, C.F.; Moss, S.Y. (UKAEA Harwell Lab. Engineering Design and Manufacture Div.). Aug 1987. 117p. NTIS (US Sales Only), PC A06/MF A01. Order Number DE88753398/JAW.

As part of a study of the absorption cycle heat pump and its potential in the UK domestic central heating market, this report describes an investigation of potential working fluids and working fluid pairs. A database of over 130 potential refrigerants, over 270 potential absorbents and over 500 possible pairings has been compiled. Physical and physiological property data have been sought for the fluids listed although for fluids other than those used in well known systems the data were scant particularly in relation to mixture properties. To enable design work to be conducted, property data tables were set up for six mixtures of the more well known

fluids. In addition, a hypothetical fluid pair was 'constructed' with desirable but realistic properties to enable cost sensitivities to be explored at the design stage. Many data are required to complete the database and continued research may be desirable if further work on the absorption cycle heat pump is to be conducted.

43380 **(AU/ME—48) Fifth annual report on the Alberta home heating research facility: results of the 1983-1984 heating season.** Ackerman, M.Y.; Dale, J.D.; Forest, T.W.; Pittman, W.; Sadler, G.W.; Wilson, D.J. (Alberta Univ., Edmonton (Canada). Dept. of Mechanical Engineering). Dec 1984. 61p. (CE—01569). CANMET/TID, Energy, Mines and Resources Canada, 555 Booth St., Ottawa, Ont., Canada K1A 0G1; $0.34CAN per page, $3.40 CAN minimum.

This report describes the facilities, which include house-like modules constructed to investigate home heating, and the research activities at a testing facility in Alberta. Results of monitoring the modules are presented, including data on air infiltration, thermal resistance of heat losses, energy consumption and effects of retrofitting and type of construction.

43381 **(BEG—BETT8211) Energy conservation considerations for the warehousing and light industrial building category. A research report.** Burnett, E.F.P. (Building Engineering Group, Waterloo, Ontario (Canada)). Nov 1983. 36p. (CE—01545). CANMET/TID, Energy, Mines and Resources Canada, 555 Booth St., Ottawa, Ont., Canada K1A 0G1; $0.34CAN per page, $3.40 CAN minimum.

This report is a synthesis of work done in the first phase of a research and development program examining energy conservation in warehouses and light industrial buildings in Canada. It covers 3 aspects: definition and quantifying of the buildings studied; identification of the nature and quantities of energy consumed in such buildings; and strategies and possibilities for implementing energy conservation measures in such buildings. It was found that there are more than 66,000 such buildings in Canada, having a total area of more than 98.5 million m/sup 2/, and this is increasing by 3-4%/y. Total energy consumed by these buildings is at least 115 million GJ/y, costing over $540 million. Ontario and Quebec represent 67% of the total; more than 80% of this energy comes from natural gas. Heating and lighting are the main end uses for this energy, although an important proportion of consumption (17%) is by refrigerated buildings. Four overall strategies for energy savings are offered, and a relatively prudent scenario for implementation is elaborated. Strategies include better energy management, thermal insulation and air infiltration prevention, and proper lighting installation, both in new construction and in retrofitting existing buildings. It is evident that over a ten-year period, around 55 million GJ of energy can be saved. In 1981 dollars, these savings can attain $240 million. 13 refs., 6 figs., 13 tabs.

43382 **(BEG—BETT8309) Shipping doors, a state of practice review. A research report.** Burnett, E.F.P.; McGlashan, J.M. (Building Engineering Group, Waterloo, Ontario (Canada)). Dec 1983. 78p. (CE—01550). CANMET/TID, Energy, Mines and Resources Canada, 555 Booth St., Ottawa, Ont., Canada K1A 0G1; $0.34CAN per page, $3.40 CAN minimum.

This report reviews the nature and use of shipping doors in warehouse and light industrial buildings. Emphasis is placed on energy-related considerations and the potential for conservation. Both the trade and technical literature are reviewed. A field survey of representative door installations in Ontario is documented. From an energy standpoint, shipping doors are important in that the annual heat energy lost through transmission and air leakage in particular is significant. In existing facilities, shipping doors are amenable, both practically and economically, to some degree of thermal retrofit. Insulating and sealing products are available, and the payback on retrofit is relatively short. In a new building, the intelligent location and selection of shipping doors can lead to significant annual and long-term benefits. The benefits are likely to be lower operating costs (less space heating energy) and improved productivity (improved comfort, no draughts, reduced cleaning, better security, etc.). Operating procedures, i.e., opening and closing doors, can usually be improved, often without additional cost. Attention should be focussed on reducing air infiltration. There appears to be a need for an energy analysis procedure for shipping doors that could be accepted and used on an industry-wide basis. 4 refs., 30 figs., 16 tabs.

43383 **(BR—86) Environmental design manual: summer conditions in naturally-ventilated offices.** Petherbridge, P.; Milbank, N.O.; Harrington-Lynn, J. (Building Research Establishment, Watford (UK)). 1988. 76p. The Building Research Establishment, Watford, GB. Price Pound 15.00. Order Number DE88753835/JAW.

A method of assessing the effect of the window size and type, the kind of construction and the rate of ventilation on summertime comfort conditions and daylighting in offices in the British Isles is presented. The method is intended for use early in the design procedure together with other guidance to help set design parameters - such as window size - or to check a preliminary design proposal when most design options are still open. The method can also be used to help to decide remedies for summertime overheating in existing buildings as well as identifying when acceptable working conditions can be achieved without recourse to mechanical air conditioning or ventilation.

43384 **(C—BETT8301) Retail stores: energy consumption and potential savings. A research report.** (Cogesult, Montreal, Quebec (Canada); Engineering Interface Ltd., Willowdale, Ontario (Canada)). Aug 1983. 76p. (CE—01546). CANMET/TID, Energy, Mines and Resources Canada, 555 Booth St., Ottawa, Ont., Canada K1A 0G1; $0.34CAN per page, $3.40 CAN minimum.

This report allows the establishment of basic data on the various modes of energy consumption and possible energy savings for four major types of retail stores in Canada: supermarkets, shopping centers, large stores and small businesses. The total sales area of a store serves as a basis for defining energy consumption, since there is a direct link between this area and energy consumed. By analyzing available data it is possible to obtain the energy consumption for each type of store building, and knowing the energy consumed per unit of sales area enables evaluation of energy conservation possibilities. It was found that the total annual energy consumption in the Canadian retail sector was 33.1 TWh, with supermarkets and shopping centers using around 70% of the total; possible annual savings were estimated at 9.7 TWh, with shopping centers alone accounting for 48.7% of this possible saving. A number of effective measures are recommended for energy conservation, notably: reducing lighting in shopping centers and large stores; in oil-heated shopping centers, modification of rooftop units; in supermarkets, reducing lighting and air infiltration; and in small businesses, improving rooftop units controlling heating, ventilation and air conditioning. 23 refs., 7 figs., 28 tabs.

43385 **(CONF-880774—1) Projected natural gas and electricity use for space heating in the US between 1987 and 1995.** Johnson, G.; Massie, R.; Poyer, D. (Department of Energy, Washington, DC (USA); Argonne National Lab., IL (USA)). 26 May 1988. Contract W-31-109-ENG-38. 18p. NTIS, PC A03/MF A01; 1; GPO Dep. Order Number DE88011977/JAW.

From Gas/electricity competition for energy markets in mature economics; Luxembourg, Luxembourg (4 Jul 1988).

One prominent insight that we have drawn from our study is the dependence of the relative movement in fuel space heating shares on the turnover in housing stock and regional location. The empirical results indicate that changes in fuel shares are largely dependent on what is done at the margin in the housing market. The implication is that there is very little fuel switching occurring in the existing housing stock. Also the assumed length of time plays a relatively important role in determining changes in the fuel space heating shares. By reducing the mean lag time there is a decline in natural gas share. However, this decline in gas heat does not manifest itself in a switch to electric heat. There is very little change in share in both our 15 and 1 year cases.

43386 **(DC—BETT8307) Building population demographics and energy consumption for health care facilities in Canada. A research report.** (Dessau Consultants, Inc., Laval, Quebec (Canada)). Mar 1983. 123p. (CE—01549). CANMET/TID, Energy, Mines and Resources Canada, 555 Booth St., Ottawa, Ont., Canada K1A 0G1; $0.34CAN per page, $3.40 CAN minimum.

Results of a survey indicate that energy usage in Canadian hospitals, for the fiscal year ending 31 March 1981, averaged 2.81 GJ/m/sup 2/ and 256 GJ /bed. It was also found that the energy usage varied significantly with hospital size. Energy consumption in all Canadian hospitals, for the same fiscal year has been estimated to be 48.7 x 10/sup 6/ GJ +/- 10%. Energy consumption in special care facilities, for the same period, has been estimated at 24.9 x 10/sup 6/ GJ +/- 30%. Energy consumption in facilities for the provision of out-of-hospital insured services has not been considered in the present study. Thus, the total annual energy consumption in the health care facilities sector, as of 31 March 1981, has been estimated to be at least 73.6 x 10/sup 6/ GJ +/- 17%. Preliminary estimates suggest that the potential for conservation in hospitals ranges from 8.3 x 10/sup 6/ to 15.1 x 10/sup 6/ GJ/y, and the potential for conservation in special care facilities ranges from 2.0 x 10/sup 6/ to 3.7 x 10/sup 6/ GJ/y. For the total sector, the conservation potential ranges from 10.3 x 10/sup 6/ to 18.8 x 10/sup 6/ GJ/y. With energy costs ranging between $5 and $10 per GJ, the conservation potential is between $51.5 and $188 million annually. Includes annotated bibliography of 12 titles. 18 refs., 8 figs., 38 tabs.

43387 **(DE—111985) Set back thermostat and controller with independent multizone control.** (Daxcom Electronics, Inc., Calgary, Alberta (Canada)). Nov 1985. 130p. (CE—01654). CANMET/TID, Energy, Mines and Resources Canada, 555 Booth St., Ottawa, Ont., Canada K1A 0G1; $0.34CAN per page, $3.40 CAN minimum.

A multi-zone setback thermostat and controller has been developed. It is based on a RCA1802 microprocessor and is designed to optimize a variable air volume air conditioning system for comfort and convenience of control, while achieving energy savings. The unit reads temperatures from up to 16 zones and controls temperatures by adjusting dampers. Each zone can be independently scheduled for four different setpoints for each day. Preset values are maintained in each zone that has no user setpoints entered, enabling the unit to control the air handling system immediately on power up. An alphanumeric display enables the user to view data in memory and as it is keyed in; unauthorized use can be prevented by entering appropriate codes. This report includes detailed descriptions of the thermostat and components, including circuit diagrams, a program listing, software description, and a user manual. A market survey was conducted in Calgary, Alberta to determine the target market and a suitable marketing strategy. Results indicate a place for this product in building retrofit situations; existing pricing that was obtained shows the unit could have an installed price advantage of about $500 per zone. 7 refs., 31 figs.

43388 **(DOE/EIS—0127F-Vol.1) The Bonneville Power Administration new energy-efficient homes programs: Final environmental impact statement: Volume 1, Assessing indoor air quality options.** (Pacific Northwest Lab., Richland, WA (USA)). Mar 1988. Contract AC06-76RL01830. 194p. NTIS, PC A09;3. Order Number DE88008499/JAW.

BPA has underway marketing and incentive programs to encourage the construction of new energy-efficient homes that comply with Model Conservation Standards (MCS) developed by the Northwest Power Planning Council. These homes are designed to have lower infiltration rates than current building practices provide, which is likely to contribute to increased levels of indoor air pollutants, and may adversely affect the health of occupants. BPA's current and past new homes programs maintained ventilation rates comparable to those found in current practice homes by requiring balanced mechanical ventilation. BPA now proposes to give builders and consumers more flexibility by increasing the options for protecting indoor air quality in its new homes programs. This proposal is the impetus for this Environmental Impact Statement (EIS), which was prepared for BPA by Pacific Northwest Laboratory. BPS is preparing this EIS to assess whether other techniques maintain indoor air quality comparable to that found in homes built using current practices. Although many pollutants are potentially of great concern, our analysis concentrates on radon and formaldehyde. It is based on measured concentrations of these pollutants and measured ventilation rates in current practice. Ventilation was measured using fan pressurization tests, which measure only air leakage, and perfluorocarbon tracer gas (PFT) tests, which account for ventilation from mechanical devices and occupant behavior in addition to air leakage. These tests yielded two different estimates. We used these data to estimate pollutant concentrations and lifetime cancer rates under three alternative actions. Under all of the alternatives, radon had a much greater effect than formaldehyde. 102 refs.

43389 **(DOE/EIS—0127F-Vol.2) Assessing indoor air quality options: Final environmental impact statement on new energy-efficient home programs: Volume 2.** (USDOE Bonneville Power Administration, Portland, OR; Pacific Northwest Lab., Richland, WA (USA)). Mar 1988. Contract AC06-76RL01830. 130p. NTIS, PC A07;3. Order Number DE88008498/JAW.

This report discusses the impact of energy conservation measures on indoor air quality in various size residential buildings. This volume includes appendices on ventilation rates, indoor pollutant levels, health effects, human risk assessment, radon, fiberglass hazards, tobacco smoke, mitigation. (DLC)

43390 **(DOE/EIS—0127F-Vol.3) The Bonneville Power Administration new energy-efficient homes programs: Final environmental impact statement: Assessing indoor air quality options: Volume 3.** (Pacific Northwest Lab., Richland, WA (USA)). Mar 1988. Contract AC06-76RL01830. 115p. NTIS, PC A06/MF A01;3. Order Number DE88008497/JAW.

This report discusses the impact of energy conservation measures on indoor air quality in various size residential buildings. (JDH)

43391 **(ECRC/M—2244) Choice of equipment for fan pressurisation tests.** Dickson, D.J. (Electricity Council Research Centre, Capenhurst (UK)). Apr 1988. 15p. Electricity Council Research Centre, Capenhurst, Chester, CH1 6ES, UK.

The Capenhurst house specification requires a maximum air leakage value of 7 air changes per hour at 50 Pascals pressure difference. The fan pressurisation method is an internationally recognised procedure for measuring the air leakage of houses. Although a research tool until recently, portable easy to use equipment is now commercially available from the USA. Available test kits are reviewed in this memorandum. The Minneapolis Blower Door has been found to be effective and relatively inexpensive. Leakage testing services are also reviewed.

43392 **(EMR—1985) Design analysis of an electronic fluorescent lamp ballast.** (Department of Energy, Mines and Resources, Ottawa, Ontario (Canada)). 1985. 40p. (CE—01567). CANMET/TID, Energy, Mines and Resources Canada, 555 Booth St., Ottawa, Ont., Canada K1A 0G1; $0.34CAN per page, $3.40 CAN minimum.

This project has the overall objective of the design and preproduction development of an energy-saving electronic ballast for fluorescent lights. Such ballast would have the potential for energy conservation in buildings since the most common type of magnetic ballasts have low energy efficiency. Specific objectives of this study were to: experimentally investigate and mathematically model existing nonlinear ballast systems; analyze and evaluate compensatory components required to harmonically circulate the reactive power currently being wasted; design and produce a prototype harmonic nonlinear gyrator and/or develop a switching type nonreactive ballast; and develop a ballast to a pre-production/licensing phase. A literature search was performed, and informed talks were held with those in the industry to determine the state of the art and the parameters on which to concentrate. A detailed experimental analysis was done of behavior of fluorescent tubes as a load, both statically and dynamically. Various means of driving this load were examined, e.g. at dc or in a pulsed mode, with either unipolar or bidirectional pulses. A final design route was selected and this design was

developed in detail. A final working prototype was not realized due to overheating problems with the transistors, but this report provides a basis for further investigators, especially those undertaking a design using integrated circuits. 12 refs., 17 figs., 2 tabs.

43393 **(EMR—111983) Energy efficient masonry fireplace. Design & performance evaluation.** Warren, D.J. (Department of Energy, Mines and Resources, Ottawa, Ontario (Canada)). Nov 1983. 328p. (CE—01646). CANMET/TID, Energy, Mines and Resources Canada, 555 Booth St., Ottawa, Ont., Canada K1A 0G1; $0.34CAN per page, $3.40 CAN minimum.

This report contains the findings of an extensive research investigation into the design and performance of the masonry fireplace. It contains a comprehensive survey of literature relating to the study of the performance and efficiency of open type fireplaces. All those papers which were deemed relevant were annotated and contained in a bibliography. From the literature, and applying common sense, an improved design for the masonry fireplace was formulated and a test fireplace built along with a conventional type. A series of twenty tests was performed on these fireplaces and all of the parameters identified in the literature deemed to be important, such as room air temperature, radiation output and heat losses, were measured. A detailed analysis of the data revealed that the modified design does in fact perform more efficiently than the conventional design. In addition to redesigning and testing the fireplace, the investigations covered the requirements for replacement air and how this air could be introduced into the fireplace in a safe and efficient manner. The problem of exfiltration was also examined and in particular the various advantages and disadvantages of glass doors and chimney top dampers were investigated. Glass doors were found to reduce the amount of sensible heat lost in the flue gases but at the same time they drastically reduced the radiant energy emitted by the fireplace. Recommendatins for retrofitting existing fireplaces are made but only a few of them were tested in this investigation. Finally, the different methods for rating the efficiency of open type fireplaces are reviewed in some detail. The best and most realistic method for a masonry fireplace, electric co-heating, is discussed in depth. 40 refs., 58 figs., 69 tabs.

43394 **(EMR/ECOS—BETT8306) Case studies and educational aids survey. A research report.** (Department of Energy, Mines and Resources, Ottawa, Ontario (Canada). Energy Conservation and Oil Substitution Branch). Sep 1983. 161p. (CE—01548). CANMET/TID, Energy, Mines and Resources Canada, 555 Booth St., Ottawa, Ont., Canada K1A 0G1; $0.34CAN per page, $3.40 CAN minimum.

A survey was conducted to determine the sources of buildings energy conservation case studies and educational aids available in Canada. In total 785 consultants, educational institutions, building developers, manufacturers and government agencies were contacted. The results of this survey provide an indication of those agencies in Canada most actively involved with energy conservation in buildings, a listing of those agencies in Canada having case study information and/or educational aids materials available related to energy conservation in buildings, and a broad description of the subject area of the case studies and educational aids listed. The results of this study are intended to provide a source listing of energy conservation case studies and educational aids to the Buildings Energy Technology Transfer Program lead agencies and others conducting similar studies in the buildings sectors for use as resource materials. 17 tabs.

43396 **(EPRI-EM—5888) Performance of electronic ballasts and lighting controllers with 34-W fluorescent lamps: Final report.** Verderber, R.R. (Electric Power Research Inst., Palo Alto, CA (USA); Lawrence Berkeley Lab., CA (USA)). Jun 1988. Contract AC03-76SF00098. 55p. NTIS, PC A04/MF A01 - Research Reports Center, Box 50490, Palo Alto, CA 94303; 1; GPO Dep. Order Number DE88012290/JAW.

This study has measured the performance of energy-saving 34-watt F40, T-12, rapid-start, lite white fluorescent lamps being operated by solid-state ballasts and lighting control equipment. The performances of these lamps are compared with those of 40-watt F40, T-12 rapid-start cool white fluorescent lamp systems studied in the prior phase of this project. With the 34-watt F40 lamps and various solid-state ballasts, system efficacy ranged from 67 to 84 lumens per watt and ballast factor from 0.756 to 0.908. Average system efficacy using the 34-watt lamps exceeded that of systems using 40-watt lamps and the same solid-state ballasts by only 1 percent even though the 34-watt lamps is about 6 percent more efficacious than the 40-watt lamp. This apparent discrepancy is due to increased ballast losses when operating the 34-watt lamps. However, the system efficacy of the 34-watt lamps used with a solid-state ballast exceeded that of a 34-watt, two-lamp system using the standard core-coil ballast by as much as 29 percent. A T-8 fluorescent lamp system with a smaller lamp diameter was also included in the study. Operating this lamp with a solid-state ballast produced a high system efficacy of 90 lumens per watt, a 39 percent improvement over the efficacy of a 40-watt F40 system using the standard core-coil ballast. The use of static controllers with 34-watt F40 lamps can result in excessive flickering (46 percent) and the generation of a second harmonic as high as 96 percent of the fundamental frequency. The dynamic controllers, when used to dim the 34-watt lamps generally cannot be dimmed as low as the 40-watt lamp system without flickering. In general, the 34-watt energy-saving lamps are appropriate as a retrofit to reduce illumination levels. However, for new construction, the 40-watt F40 argon filled lamps cost less, perform better, and provide a more reliable system. 5 refs., 27 figs., 9 tabs.

43396 **(EUR—11328) Further investigations on new fluid working systems for absorption heat pumps.** Bothe, A.; Nowaczyk, U.; Schmidt, E.L. (Essen Univ. (Gesamthochschule) (Germany, F.R.). Inst. fuer Angewandtle Thermodynamik und Klimatechnik). 1987. 196p. (In German). NTIS (US Sales Only), PC A09; 1; GPO Dep. Order Number DE88012622/JAW.

This project comprises two parts: in part I work on new working fluid systems was continued and extended, in part II first steps in testing new working fluid pairs in real heat pump cycles have been undertaken. The new working fluid systems are of the low pressure type and have been investigated as to their applicability for heat pumps and heat transformers. Special concern is given to molecular theoretical considerations leading to suitable fluid combinations with high mutual solubility. The donor-acceptor-properties of the functional groups are important. Solubility depends on the existence of H-bridges, in which the donator's potential is characterized by its acidity and the acceptor's potential by its basicity. Trifluoroethanol (TFE), hexafluoroisopropanol (HFIP) and perfluoropropionic acid (PFPA) have been selected for further investigations. Suitable absorbents could be found in the cyclic derivates of the N-alcyled urea, lactams, oxazolidinones, morpholines, carbonates and sulfones. Results are presented.

43397 **(GKYA—BETT8305) Verification of the BLAST computer program for houses. A research report.** (Yuill (G.K.) and Associates Ltd., Winnipeg, Manitoba (Canada)). Nov 1983. 54p. (CE—01547). CANMET/TID, Energy, Mines and Resources Canada, 555 Booth St., Ottawa, Ont., Canada K1A 0G1; $0.34CAN per page, $3.40 CAN minimum.

This report undertakes a process to evaluate the accuracy of the BLAST computer program, used for thermal performance evaluations of houses. Field trials were done at two test houses in Alberta, comparing the predictions of the program to the actual data on temperature and energy consumption. One house was of energy-efficient construction and the other was of the traditional type. Data were compared during 3-day periods at different times of the year. It was found that the BLAST predictions generally agreed with the measured thermal performance. The discrepancies observed can be attributed to various factors: the fact that the meteorological data were supplied from a site distant from the test houses; the effective thermal resistance calculated and used by BLAST did not correspond perfectly to the data measured at the house walls; and the correlation of air infiltration was extrapolated starting from measurements extending over 3 months, and the sun temperatures used for the forecasts was based on those of a site 100 km away. Although improvements in the prediction ability are thus possible, the time and effort involved would not be justified. 16 figs., 13 tabs.

43398 (HAA—111983) Mechanical systems data book. (Hooper and Angus Associates Ltd., Toronto, Ontario (Canada)). Nov 1983. 168p. (CE—01530). CANMET/TID, Energy, Mines and Resources Canada, 555 Booth St., Ottawa, Ont., Canada K1A 0G1; $0.34CAN per page, $3.40 CAN minimum.

This Data Book describes the mechanical systems and their operations for Canada Centre, the Government of Canada building located in Scarborough, Ontario. This building was designed for optimum energy efficiency and achieves this through proper selection of a number of available heating and cooling systems. These include cooling towers, an aquifer heat storage, a solar heating system, electric boilers, heat exchangers and associated hardware and control systems. The purpose of this book is to outline in a general way, the overall system concept and various innovative energy saving modes of operation that provide heating and cooling for the building. Contents of this data book are intended to supplement the more detailed written data and instructions provided by the equipment suppliers. 25 figs.

43399 (HME—111985) Survey of medium and high efficiency gas furnaces. Phase 1 report. Mayhew, W.J. (Howell Mayhew Engineering, Inc., Edmonton, Alberta (Canada)). Nov 1985. 18p. (CE—01653). CANMET/TID, Energy, Mines and Resources Canada, 555 Booth St., Ottawa, Ont., Canada K1A 0G1; $0.34CAN per page, $3.40 CAN minimum.

The heating industry in Canada has experienced a technological revolution that is resulting in major changes to residential heating systems. In Alberta, it is estimated that 25% of the furnaces currently sold are medium and high-efficiency units and the number is growing each year. The introduction of these appliances has not been without problems. Research is being carried out in a number of areas to determine the extent of some of these problems and to provide solutions. This report outlines the past and current research and development work of organizations in Canada and the US, summarizes their concerns and describes how high-efficiency space heating can be expected to develop in the future. The areas of major concern were corrosion, condensation related to venting, poor installation nd servicing practices, high service and maintenance costs, indoor air quality and the lack of testing standards.

43400 (KCER—BETT8207) The performance of gas furnaces in five well-insulated houses: a field study of gas furnace performance in relation to furnace sizing and space heating load. A research report. Yousa, M.J; Hicklin, J.N. (Kananaskis Centre for Environmental Research (Canada)). Oct 1982. 119p. (CE—01589). CANMET/TID, Energy, Mines and Resources Canada, 555 Booth St., Ottawa, Ont., Canada K1A 0G1; $0.34CAN per page, $3.40 CAN minimum.

An investigation has been conducted on the relation between furnace oversize and seasonal efficiency. Five Alberta houses, containing natural gas furnaces with oversize factors ranging from 34% to 133%, were selected for the investigation and measurements were taken of various furnace performance parameters. It has been shown that the performance of the furnace is affected substantially by many factors, including the anticipator setting, thermostat type and location, and configuration of the air distribution system. These factors, which varied considerably from one house to another, made it difficult to isolate the correlation between furnace oversize and seasonal efficiency. The houses with furnaces which were oversized by more than 50% exhibited conditions of short cycling when the thermostat anticipator was set to specifications provided by furnace manufacturers, or the setpoint noted in the original thermostat. When the anticipator was adjusted to eliminate the condition of short cycling, furnace performance improved in the case where the furnace was oversized by 133%. It has also been noted that the temperature setpoints of the furnace fan control significantly effect the performance of the heating system. It is suggested that the interaction of the temperature setting of the thermostat, the anticipator setting, and the fan controls may contribute to reduced seasonal efficiency of the house as a total heating system, when internal gains, solar gain, and ventilation rates are considered. 6 refs., 46 figs., 23 tabs.

43401 (LEC—111985) Townhouse retrofit demonstration project, 1983-1985. Final report. (Love Energy Consultants, Calgary, Alberta (Canada)). Nov 1985. 61p. (CE—01636). CANMET/TID, Energy, Mines and Resources Canada, 555 Booth St., Ottawa, Ont., Canada K1A 0G1; $0.34CAN per page, $3.40 CAN minimum.

Tests were conducted over the 1983-1984 and 1984-1985 heating season in unoccupied townhouses in northwest Calgary. Gas consumption was monitored through each heating season by taking daily meter readings and correcting gas use for outdoor temperature variations. Infrared scanning and depressurization were used to analyze the condition of the building envelope. Defects such as missing insulation in wall cavities and extensive air leakage through wall joints would not be remedied by common conservation measures. Temperature differences as great as 6/sup 0/C were noted between upper and main levels. The second pair of townhouses studied were much better constructed. Only slight deficiencies in insulation were noted. Conservation measures applied to both units yielded reductions in gas consumption of only 10%. It was observed in implementing conservation measures that conditions are frequently encountered in the field that make it difficult to carry out measures as they are described in guides to thermal upgrading. Projected payback periods were about 2 years for basic air-sealing measures such as caulking sill plate joints and weatherstripping. Projected payback periods exceeded 5 years for measures such as basement insulation. Further research is needed to develop a better understanding of the thermal behaviour of row housing, and of the efficancy of particular measures for thermal upgrading. 12 refs., 27 figs., 7 tabs.

43402 (NP—8770257) Numerical simulation of the energy consumption and temperature characteristics of rooms as representative parts of buildings. Troeltsch, M. (Technische Univ. Muenchen (Germany, F.R.). Fakultaet fuer Maschinenwesen). 21 Oct 1986. 235p. (In German). NTIS (US Sales Only), PC A11/MF A01. Order Number DE88770257/JAW.

The study discusses the development of a precise mathematico-physical model designed for the numerical simulation of the energy consumption and heat transfer of rooms as the representative parts of buildings. Annual simulations are based on an individual test reference year developed for the city of Munich and Upper Bavaria, respectively. Thermal comfort requirements, i.e. maximum admissible room temperatures, are met using an innovative efficient shading system and individual fresh air ventilation systems. The artificial illumination admitted depends on the given daylighting conditions. A sensitivity analysis investigates into the results obtained using different models and assesses the effects of physical parameter variations on the annual energy consumption and temperature characteristics of a representative room. Parametric variations allow to determine the influence of front designs on annual heat consumption in accordance with thermal comfort requirements. The variations applied refer to rooms serving different uses, facing different directions, and characterized by different types of windows and lightweight-to-heavy constructions. (orig.)

43403 (NRC/BR—192) Effect of a gas furnace chimney on the air leakage characteristic of a two-story detached house. Building Research Note, No. 192. Shaw, C.Y.; Brown, W.C. (National Research Council of Canada, Ottawa, Ontario. Div. of Building Research). Jul 1982. 15p. (CE—01588). CANMET/TID, Energy, Mines and Resources Canada, 555 Booth St., Ottawa, Ont., Canada K1A 0G1; $0.34CAN per page, $3.40 CAN minimum.

An experimental assessment was made of the effect of a chimney on the air leakage characteristic of an unoccupied, two-storey detached house in Ontario, as heated by either gas or electric furnace. Measurements were taken of air tightness values and air infiltration rates with the chimney capped and uncapped. Infiltration rates were also measured during operation of the electric furnace. The overall air infiltration rate was greater with the gas furnace than with the electric furnace under the same weather conditions, and the difference was smaller than the air flow rate through the chimney. When the gas furnace was in operation, stack action was the dominant driving potential for air infiltration, with

wind speeds up to 7 m/s (16 mph) and with inside-to-outside temperature differences greater than 20/sup 0/K (35/sup 0/R). 9 refs., 10 figs.

43404 **(PW—1982) Overview of Canadian aquifer thermal energy storage field trials.** Morofsky, E.L. (Public Works Canada, Ottawa, Ontario). 1982. 9p. (CE—01568). CANMET/TID, Energy, Mines and Resources Canada, 555 Booth St., Ottawa, Ont., Canada K1A 0G1; $0.34CAN per page, $3.40 CAN minimum.

The Department of Public Works, as part of its seasonal energy storage program, has sponsored two aquifer thermal energy storage field trials at major Canadian government building sites in the Toronto area. The objective of these trials is to assess the practicality of implementing cost-effective storage within the constraints of modern building design and operation. Both projects have been designed based on site specific data and modelling. Long range monitoring and evaluation plans are being developed. The first project involves the storage of chilled water produced by exposing the aquifer water to the cold winter air. The second project involves a building under construction, featuring a heat pump design with waste building heat and solar collectors as possible heat sources for aquifer storage. 11 refs., 3 figs., 1 tab.

43405 **(SERC-GR/E—05193) Future of building energy modelling in the UK. A report to the Building Sub-Committee.** Clarke, J.A. (Science and Engineering Research Council, Swindon (UK)). Feb 1987. 70p. British Library Document Supply Centre, Boston Spa, Wetherby, West Yorks. LS23 7BQ.

After stressing the importance of the energy costs in UK buildings, the results of a short study of the current models used to predict building energy usage are discussed. Barriers to the effective use of computer based design tools are outlined. It is concluded that a research club should be established to coordinate the research programme and which would fund itself from member subscription and cash grants from industry and government.

43406 **(SS—2) Final report on the design of the Anzac Community Centre.** (Sunergy Systems Ltd., Tom-ono, Alberta (Canada)). Jan 1983. 37p. (CE—01647). CANMET/TID, Energy, Mines and Resources Canada, 555 Booth ST., Ottawa, Ont., Canada K1A 0G1; $0.34CAN per page, $3.40 CAN minimum.

The design of a solar heated, energy efficient community centre for a village located near Fort McMurray, Alberta has involved the incorporation of a number of interesting features. Stackwall construction was chosen for much of the exterior walls. A large greenhouse/sunspace provided a strong transition between interior and exterior as well as providing abundant daylighting and solar gain. Other highlights included sub-floor thermal storage, earth berming, waterless composting sanitation system, air lock entries, and thermal zoning as well as a number of unique architectural features. Monitoring equipment was installed for future performance evaluation. A computer thermal analysis showed an initial annual space heating cost of $100, excluding any contribution from auxilliary wood combustion. The design offers a model for communities or agencies seeking an exciting response to their needs. 11 figs., 3 tabs.

43407 **(VTT-TIED—737) Fault operations and susceptibility to disturbing factors of ventilation systems.** Heikkinen, J.; Korkala, T.; Luoma, M.; Salomaa, H. (Valtion Teknillinen Tutkimuskeskus, Espoo (Finland)). Jul 1987. 157p. (In Finnish). NTIS (US Sales Only), PC A08. Order Number DE88752090/JAW.

The investigation describes the most typical fault operations of the ventilation systems, the causes of them and means to avoid these defects. The fault knowledge based on many research projects carried out during last years was collected together. Besides, the fault operations were gathered from checking minutes of business and office buildings and a hospital complex. The distribution of the supply air was measured in a few flats. The reasons for and the cures of the defects were sought by analysing. The influences of the disturbing factors (weather, wrong use, leaky constructions etc.) on the operation of the ventilation systems were studied computionally. The most typical defects of the ventilation proved to be: draught, bad smell of indoor air, spreading of odours between and inside flats, condensation on windows, noise. The most important fault operations from the viewpoint of energy consumption and indoor climate are linked with heaters, fans, dampers and heat recovery units. The problems are often caused by a defective intake of outdoor air or air distribution, incorrect adjustment or poor air tightness of external and internal constructions or ducts. Many defects date from the construction process, but in most cases the reasons are due to failures of operation and maintenance. The main point in avoidance of the defects is to build as simple clear-cut ventilation systems as possible. Because of the stability and the easy adjustment of the systems, the duct pressures must be high, pressure drops in ducts low and in terminal devices high. Highly developed preliminary preparations make possible installations, where building-time adjustments and handwork are minimized. It is very important to set exact targets for the design and contract and to supervise the work.

43408 **(YU—081982) An interim assessment of the Energuide program.** Tryfos, P.; Fenwick, I. (York Univ., Toronto, Ontario (Canada)). Aug 1982. 116p. (CE—01607). CANMET/TID, Energy, Mines and Resources Canada, 555 Booth St., Ottawa, Ont., Canada K1A 0G1; $0.34CAN per page, $3.40 CAN minimum.

The Energuide program required Canadian appliance manufacturers to label their products to show their electric energy consumption under standard test condition in order to encourage consumer awareness of possiblities of energy conservation in this area. This paper, based on the Energuide program, analyzes the changes in home appliances with respect to their energy consumption and the kinds of evaluations consumers make when choosing such appliances. The types of appliances considered are refrigerators, freezers, stoves, washing machines, dryers, and dishwashers. The research is based on information taken from the Energuide program, from documentation supplied by manufacturers and retailers, and from an appliance price survey in a metropolitan area. Mulivariate analysis is used to consider the simultaneous influence of a number of variables. A theoretical model is detailed for describing consumer choices, from which an empirically estimable relation between prices and features is obtained. Two main conclusions are offered. Most home appliances sold in Canada in 1982 consume much less energy than those models offered at the start of the Energuide program (1978), and average electricity consumption for these appliances has decreased more than was predicted. Consumers appear to attach importance to energy efficiency when purchasing an appliance, perhaps less than is warranted by rational economic calculation and the economic conditions of the moment. It seems that programs like Energuide have not yet exhausted all the possibilities of improving energy conservation. 26 refs., 23 tabs., 30 figs.

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43409 **(BA—061982) Product characteristics that reduce energy use: the case of automobiles. Final report.** (Berkowitz (M.K.) and Associates Ltd., Thornhill, Ontario (Canada)). Jun 1982. 126p. (CE—01583). CANMET/TID, Energy, Mines and Resources Canada, 555 Booth St., Ottawa, Ont., Canada K1A 0G1; $0.34CAN per page, $3.40 CAN minimum.

The primary goal of this study is to identify the characteristics that influence the energy efficiency of automobiles and determine how the value of these characteristics to consumers has changed in response to changing gasoline prices. Relevant literature was reviewed, and a theoretical construct developed that relates product attributes to consumers' utility, to determine amounts consumers are willing to pay for various product characteristics, which in turn will indicate how much energy prices must rise in order to effect a change in consumption. Energy-reducing product characteristics were examined and related to an economic pricing model; test results of the model were developed, and the model was applied to automobile purchases and potential energy savings. The impact of uncertain technological development on short-run energy savings was discussed, with some examination of the applicability of the model to furnace purchases. It was determined that for each of

the years 1977-1980, in which Canadian automobile efficiency data were available, vehicle weight and displacement consistently explained over 80% of the variation in energy efficiencies across automobiles. Among the more interesting results of the pricing model, it was observed that the interior volume of vehicles was only considered important by consumers in 1980, following major downsizings in the industry. An increase in energy prices decreased both the value attached to weight and additional cylinders by consumers. Analytical results suggest that the greater the market power of firms in the industry, the lower the level of durability supplied which may be in the consumers' interests. 47 refs., 2 figs., 28 tabs.

43410 **(DE—101982) Comparison of summer and winter on-road fuel consumption of four vehicles.** (Davis Engineering Ltd., Ottawa, Ontario (Canada)). Oct 1982. 65p. (CE—01596). CANMET/TID, Energy, Mines and Resources Canada, 555 Booth St., Ottawa, Ont., Canada K1A 0G1; $0.34CAN per page, $3.40 CAN minimum.

The objectives of this project were to experimentally determine summer fuel consumption values and analyze the difference between summer and winter fuel consumption values utilizing a selected number of cars, drivers and highways. Winter fuel consumption values were determined under a separate project. Fuel consumption values obtained for tests performed during the winter were 7% to 30% higher than those performed during the summer. In general this difference increased with vehicle size. The driving profiles for the two drivers examined were essentially similar for both summer and winter runs performed indicating consistent driving practices for each driver. An abundance of data has been created for different ambient temperature conditions for four specific vehicles. With further analysis this should provide a valuable basis in ascertaining the fuel consumption differences for over the road driving between summer and winter ambient conditions. 2 refs., 24 figs., 21 tabs.

43411 **(DLC—041272A) Estimation of excess fuel consumption attributable to tire underinflation and an evaluation of selected countermeasures. Phase 1. Final report.** (DelCan DeLeuw Canada Ltd.). Nov 1982. 57p. (CE—01598). CANMET/TID, Energy, Mines and Resources Canada, 555 Booth St., Ottawa, Ont., Canada K1A 0G1; $0.34CAN per page, $3.40 CAN minimum.

Tire underinflation has a direct impact on fuel consumption, as well as safety and tire wear. Underinflated tires increase rolling resistance thereby requiring a greater portion of the power produced by the vehicle engine to overcome this force. It is estimated that approximately 3-5% of total vehicle power is required for this purpose. Any reduction in the rolling resistance of tires will improve vehicle fuel economy. One potential means of reducing rolling resistance is by maintaining inflation pressure at recommended levels. It is apparent that the fuel saving potential of this strategy is large for cars. One source has stated that by increasing tire inflation pressure from 21 psi to 35 psi, an oil saving of 170 x 10/sup 6/ bbl would result. Assuming a conversion efficiency of 0.8 this would result in a saving of some 50 or so gallons of gasoline per car per year. There appears to be even greater potential for trucks due to the impact of widely varying loads and, for various reasons, it is suggested that underinflation of truck tires is a common occurrence. Certain data are available on the extent of underinflation of car tires but no data exist with respect to truck tires. It is proposed that a limited survey of car tires be undertaken to validate and update the previous data, and that a survey of trucks be initiated. Estimates of the fuel use impact due to underinflation have been derived from the literature. It is proposed to apply these figures to the underinflation survey data. In this manner an estimate of excess fuel consumed due to observed levels of underinflation will be obtained. This fuel volume can be converted to cost. 41 refs., 9 figs., 2 tabs.

43412 **(EA—091982) Energy management in the Canadian airline industry.** (English (J.S.) Associates Ltd., Ottawa, Ontario (Canada)). Sep 1982. 21p. (CE—01599). CANMET/TID, Energy, Mines and Resources Canada, 555 Booth St., Ottawa, Ont., Canada K1A 0G1; $0.34CAN per page, $3.40 CAN minimum.

The purpose of this report was to outline the current status of the Canadian airline industry's energy performance and to outline energy management programs undertaken within the industry. The study also provides an aviation energy management information base developed through a comprehensive computer bibliographical review. A survey of the industry was undertaken, the results of which are incorporated in this report. The Canadian airline industry has recognized the importance of energy management and considerable measures have been introduced to become more energy efficient. The largest single contributor to improved productivity is the acquisition of energy efficient aircraft. Larger airlines in particular have implemented a number of conservation techniques to reduce fuel consumption. However, both large and small airlines would further benefit through incorporating techniques and programs described in the annotated bibliography in this study. Rising fuel prices and economic uncertainties will be contributing factors to a smaller average annual growth in fuel consumption during the 1980s. The lower consumption levels will also be a result of continuing energy conservation awareness, new technology improvements, and improvements in air traffic control. 98 refs., 4 figs., 6 tabs.

43413 **(EMR/TE—TE822) Fuel consumption and associated trends in new automobiles, 1975-1980.** (Department of Energy, Mines and Resources, Ottawa, Ontario (Canada). Transportation Energy Div.). Jul 1982. 54p. (CE—01590). CANMET/TID, Energy, Mines and Resources Canada, 555 Booth St., Ottawa, Ont., Canada K1A 0G1; $0.34CAN per page, $3.40 CAN minimum.

This publication describes the major trends in fuel consumption and physical characteristics of new automobiles over the 1975-1980 period in Canada. The information is mostly aggregated across provinces but some disaggregation is provided by manufacturer and source of automobiles (i.e. domestic and foreign). The data used to compile the information in this report are drawn principally from a data base called the Motor Vehicle Characteristics Data Base. It provides information for each model of vehicle sold in Canada since the 1975 model year and includes their physical attributes such as engine type, displacement, inertia weight and curb weight, fuel type, interior volume and fuel consumption, as well as sales data. The fuel consumption ratings (city, highway, and combined) and interior volume indices are obtained from annual publications of the US EPA and Transport Canada. The remaining parameters (curb weight, engine size, number of cylinders and fuel type) are obtained mainly from the almanac issues of Automotive News. 25 figs., 23 tabs.

43414 **(IBI—TP071983) A conceptual framework for urban transportation energy management. Final report.** Stewart, S.E.; Sims, J.D.; Walsh, K.; Irwin, N. (IBI Group, Toronto, Ontario (Canada)). Jul 1983. 82p. (CE—01544). CANMET/TID, Energy, Mines and Resources Canada, 555 Booth St., Ottawa, Ont., Canada K1A 0G1; $0.34CAN per page, $3.40 CAN minimum.

This study assesses the national energy impacts of various urban transportation management measures in Canada, taking into account the suitablility of the measures by size of urban centre. The major elements of the report include: an estimate of urban transportation system characteristics for various sizes of cities, an estimate of urban transporation energy consumption by the various city sizes and the associated national urban energy consumption, taking into account the total number of urban areas, a review of various transportation management measures and the associated energy impact, an evaluation of the ten best measures for each city size, and a recommended program of research and development taking into account the potential energy savings of the various measures. It was found that the two largest city size groupings, consisting of approximately 9 urban centres, account for over 60% of the national base energy consumption. A summary of the costs and cost-effectiveness of each of the 23 energy management measures by each of the city size groupings indicates that with the larger city sizes, the average cost-effectiveness for all of the measures improves. If all of these measures were implemented for all city size groupings, the total urban energy consumption would be reduced by approximately 2.7%. If all of the 10 best measures for each city size grouping were implemented, the potential annual savings would be approximately 525 million litres of fuel. The largest potential savings are in Ontario, the smallest in the Atlantic provinces. Traffic measures ac-

count for the largest potential savings, approximately 70% of the total. 114 refs., 3 figs., 23 tabs.

43415 (JAPA—TP4569E) Shared vehicle fleet concepts. State-of-the-art review and R & D program definition. Final report. (Parviainen (Jouko A.) and Associates, Oakville, Ontario (Canada)). Jun 1983. 72p. (CE—01532). CANMET/TID, Energy, Mines and Resources Canada, 555 Booth St., Ottawa, Ont., Canada K1A 0G1; $0.34CAN per page, $3.40 CAN minimum.

A state-of-the-art review of shared vehicle fleets (SVF), based on extensive literature review and discussions with managers of major recent experiments, indicates that past attempts to use SVF as circulation systems in central business districts have failed, and that emphasis is now shifting to residential co-operatives managed by transportation brokers, and other previously untested innovative schemes. The report presents an assessment of factors that must be clearly specified to ensure successful operation of any SVF enterprise (e.g. membership and fleet composition, service definitions, and user charges and agreements). Based on review of recent socio-economic and travel trends, there appears to be significant theoretical opportunity for implementing SVF schemes in Canada, mainly due to the economic pressures on households to reduce their transportation expenditures, the significant time/space flexibilities in current discretionary travel, and the increased flexibilities in all travel resulting from the expected alternative work schedule and communications developments. However, because of the immense complexity of predicting consumer choices in this intricate attitude/behaviour vs cost savings trade-off, only the implementation of a carefully designed demonstration program can establish the true propensity of Canadian households to join, and to continue to practice in, SVP enterprises. This report recommends a six-step program for demonstrating the feasibility of implementing SVF operations in Canada. 33 refs., 7 figs., 17 tabs.

43416 (OC—266) Automobile misfueling study. Results of a national public opinion survey. Final report. (Optima Consultants, Ottawa, Ontario (Canada)). 28 Jan 1986. 110p. (EN;FR). (MICROLOG—88-02241). Environment Canada, Publications Section, Terrasses de la Chaudiere, Ottawa, Ont., Canada K1A 0H3; $N/C; MF CANMET/TID, Energy, Mines and Resources Canada, 555 Booth St., Ottawa, Ont., Canada K1A 0G1; $10 CAN.

As a response to concern in Canada that some motorists use leaded gasoline on vehicles designed to use unleaded, a study was conducted to investigate this problem. Its objectives were to assess the degree of, determine the prevalent manner of, and observe any parameters affecting misfueling in Canada, to ascertain any misfueling trends based on results of a previous study, and to determine reasons for misfueling. Surveys were conducted in 10 communities across Canada based on a stratified random sample of gas stations and vehicular observations. It was observed that at 7% of service stations, at least one of the leaded gasoline pump nozzles had been switched, i.e. a smaller nozzle was put on the leaded pump, facilitating misfueling. 73% of motorists were observed to refuel with unleaded gasoline, while 27% refueled with leaded. Based on a sample of vehicles weighted in accordance with community size, 74% are designed to use unleaded gasoline and 26% leaded. Out of a sample of 3,128 vehicles designed to use unleaded, 474 were filled with leaded. It would appear that misfueling tends to be highest in areas without provincial regulations prohibiting this practice. Among the 26% of motorists driving vehicles designed to run on leaded gasoline, 32% are fueling with unleaded. The principal method of misfueling appears to be through modification of the vehicle's receptacle (91%); availability of substituted nozzles at the leaded pump accounts for 4% while a slow filling of the tank makes up the rest. Among the 12% who misfuel, 58% say the principal reason for using leaded gasoline is their perception that the vehicle is designed to use leaded; 32% attribute their choice to the cheaper price of leaded. 29 tabs.

43417 (RTAC—021983) Inventory of fuel and engine testing facilities in Canada. Poole, A.L. (Roads and Transportation Association of Canada, Ottawa, Ontario). Feb 1983. 138p. (EN;FR). (CE—01540). CANMET/TID, Energy, Mines and Resources Canada, 555 Booth St., Ottawa, Ont., Canada K1A 0G1; $0.34CAN per page, $3.40 CAN minimum.

This inventory identifies institutional, industrial and postsecondary education centres of capability in areas of fuel analysis and engine testing across Canada. Profiles for each centre are arranged alphabetically by the name of the unit. Each profile contains some or all of the following elements: name, address, telephone, telex, principal contact, year established, number and type of personnel, general description of the facility, test support and equipment, test engines, fuels and other energy forms tested, test work performed, contracting status, international affiliations/organizations/memberships, and area of jurisdiction. Copies of the survey questionnaire, covering letters plus the list of candidates are reproduced in the appendices

43418 (SS/MC—021983) Evaluation assessment of Rail Freight Transportation Research and Development Program. (Supply and Services Canada, Ottawa, Ontario. Bureau of Management Consulting). Feb 1983. 102p. (CE—01543). CANMET/TID, Energy, Mines and Resources Canada, 555 Booth St., Ottawa, Ont., Canada K1A 0G1; $0.34CAN per page, $3.40 CAN minimum.

This report presents an evaluation assessment of the Canadian Rail Freight Transportation Research and Development (R & D) Program. The assessment was to assist in preparing for an evaluation of the Program and to stimulate a better understanding of the broader issues and problems of evaluating R & D programs. In general, the objectives of the program are aimed at improving rail freight productivity, capacity, safety, cost, and the domestic and foreign competitive position of railway suppliers. This is to be accomplished by stimulating a stronger industry commitment to R & D and inducing investment in new technology through joint federal-industry funding and participation in rail freight R & D projects. In view of the low funding levels of the Program, it is unlikely that it will have a significant direct impact upon these ultimate objectives. Impacts will likely only be achieved through the Program's ability to stimulate increased industrial R & D and investment in new technology. A model of the Program developed in the report shows that the critical linkages between the activities and objectives of the Program are the leadership or advocacy functions performed by the Program's managers and of the results of projects supported under the Program; and the processes of program planning and project selection. An assessment of the Program's structure indicates that there are no significant issues that would make the evaluation of the Program or its major components inadvisable. Twelve potential evaluation questions and the basic approaches required to address each of them are presented in the report. 5 figs., 10 tabs.

43419 (TC/RS—TMSE8301) Presentation on fuel consumption survey results, March 1983. Lawson, J.J. (Transport Canada, Ottawa, Ontario. Road Safety). Mar 1983. 23p. (CE—01528). CANMET/TID, Energy, Mines and Resources Canada, 555 Booth St., Ottawa, Ont., Canada K1A 0G1; $0.34CAN per page, $3.40 CAN minimum.

The Fuel Consumption Survey was undertaken by Statistics Canada under contract to Transport Canada. The survey began in mid-1979, obtaining information on private use passenger cars, and at the beginning of 1980 a subsidiary survey of light trucks and vans was initiated. This report presents some results form the survey available at March 1983. This memorandum records a presentation attempting to interpret the findings of the survey to date, emphasising those of greatest interest to the Department in its functions of transport and energy planning, as well as in monitoring the effects of the programme of voluntary vehicle fuel consumption standards. This memorandum presents copies of the slides used in the presentation, with numerical values placed on all the graphical representations, and with the notes to each slide typed beneath. Data examined in the presentation involve model year, vehicle weight and other characteristics, distance driven, fuel type, and fuel

consumed. Some comparisons with previous years are made. 15 figs., 6 tabs.

43420 **(TC/TDC—TP4428E) Proceedings of the Transportation Development Centre Railway Energy Seminar.** (Transport Canada, Montreal, Quebec. Transportation Development Centre). 15 Mar 1983. 127p. (CE—01644; CONF-8303232—). CANMET/TID, Energy, Mines and Resources Canada, 555 Booth St., ottawa, Ont., Canada K1A 0G1; $0.34CAN per page, $3.40 CAN minimum.

From Transportation development centre railway energy seminar; Montreal, Canada (15 Mar 1983).

The proceedings from a Canadian railway energy seminar are presented in this document. Topics include railway energy conservation activities, alternative rail diesel fuels, energy efficient locomotive developments, railway electrification, and the federal energy research and development program. A summary of the discussion which took place at the end of the seminar is also given. Separate abstracts have been prepared for five papers from this seminar.

3203 Industry And Agriculture

REFER ALSO TO CITATION(S) 42644, 42711, 42907, 43356, 43371, 43373, 43624, 43626

43421 **(AC/EAP—041983) The potential for a sustained energy supply from combustible crop residues in the Canadian Agriculture and Food System.** Colwell, H.T.M. (Agriculture Canada, Ottawa, Ontario. Energy Analysis and Policy Div.). Apr 1983. 65p. (CE—01556). CANMET/TID, Energy, Mines and Resources Canada, 555 Booth St., Ottawa, Ont., Canada K1A 0G1; $0.34CAN per page, $3.40 CAN minimum.

This study concludes that 6.5 to 7.4 million tonnes (at field moisture levels) of the more than 40 million tonnes of agricultural crop residues produced annually in Canada could potentially be available for energy production purposes. The quantities available are heavily constrained by existing demand for soil reincorporation, animal feeding and bedding purposes. Characteristics of the feedstock, probable energy conversion processes, type of energy produced, energy utilization options and preliminary economic evaluation suggest that crop residue based energy production systems can provide regionally and locally important development opportunities to produce energy for static applications within the farm sector. Gasification or combustion systems at a farm or community level are likely to be the most probable scale of energy production. It is estimated that over 11,000 Canadian farms might have residues in sufficient quantities to justify farm or community level energy production systems. Preliminary economic analysis indicates that feedstock costs and capital costs per unit of energy produced are critical factors affecting the cost of producing energy from crop residues. Feedstock costs are heavily dependent on the opportunity cost of the crop residue. Corn cobs and chaff, which currently have little or no value for alternative uses, merit special attention as possible feedstocks. This analysis suggests that for specific applications and specific regions, the cost of energy produced from crop residues can be similar to the retail price of propane and heating oil but is, in general, not competitive with natural gas. 14 refs., 2 figs., 24 tabs.

43422 **(AC/EAP—061982) An economic overview of energy use and adjustment potential in the agri-food production sector.** Colwell, H.T.M. (Agriculture Canada, Ottawa, Ontario. Energy Analysis and Policy Div.). Jun 1982. 32p. (CE—01592). CANMET/TID, Energy, Mines and Resources Canada, 555 Booth St., Ottawa, Ont., Canada K1A 0G1; $0.34CAN per page, $3.40 CAN minimum.

The agri-food system consumes approximately 15% of energy used in the Canadian economy. Energy use in the production sector is peculiar in two respects when compared with other sectors. Firstly, energy costs form a much higher proportion of total operating costs than for other businesses. Secondly, indirect uses of energy are at least as economically important as direct use of liquid fuels. The potential to increase energy productivity is likely to be substantial. Cost impacts experienced by industry members under post-National Energy Policy price structures will be substantial unless rapid adjustment is achieved through conservation or adoption of existing and new energy efficient technologies. The primary production sector is composed essentially to individual small businesses which lack the capital and human resources needed to conduct research. Successful energy research investments made in the near future should generate technologies for adoption in the latter part of this decade which should impact on production cost, food prices to the consumer and export competitiveness. Improved information is the primary short-term priority for energy adjustment purposes. Research priorities in the short-run are likely to emphasize energy conservation technologies, particularly those of relevance to the crop sector. Available evidence suggests that the quantities of energy saved from energy conservation are likely to be substantial ranging up to 60% for individual technologies and 20% to 30% for individual production systems. Energy production from the agri-food sector, presents an opportunity to provide increased longer-term energy supply security for the agri-food sector and potentially to supply a part of the national fuel needs. 23 refs., 3 figs., 9 tabs.

43423 **(AC/ITA—111983) Economics of crop residue gasification systems.** Nemetz, I. (Agriculture Canada, Ottawa, Ontario. Inputs and Technology Analysis Div.). Nov 1983. 46p. (CE—01555). CANMET/TID, Energy, Mines and Resources Canada, 555 Booth St., Ottawa, Ont., Canada K1A 0G1; $0.34CAN per page, $3.40 CAN minimum.

Crop residues have been advanced as a potential energy source on Canadian farms. One technology being examined to convert crop residues to useable energy is gasification. The purpose of this paper was to identify the maximum capital investment in a gasification system which is economically justified, and to assess the potential benefits attainable if technically acceptable gasification systems could be developed and widely adopted in Canada. A computer model was used to determine the break-even investment for all required facilities both for corn and small grain residues. A base case was constructed using technical data from systems currently under development. The effects of varying both technical and economic factors on the potential investment were investigated. It was found that the level of investment was most sensitive to grain harvest moisture content, rate of increase in LPG prices, and discount rate. Tax issues were examined and not found to affect investment. The major finding was that significant amounts of crop residues remain available after grain drying requirements have been met which are available for generating energy for other farm uses. Combination of different feedstocks is also feasible and this further increases the potential energy supply and the maximum level of investment, making it more likely that commercialization of gasification can proceed. The potential energy replaceable on a regional and national level is very significant; results showed if all farms drying grain corn and wheat used acceptable amounts of excess residues to replace energy sources used for drying and other farm demands, the savings would amount to the equivalent of 167 million liters of LPG fuel per year. 3 refs., 14 figs., 29 tabs.

43424 **(ACS—031984) Feasibility study for the use of chemical heat pumps in Canadian industry.** (Acres Consulting Services Ltd., Niagara Falls, Ontario (Canada)). Mar 1984. 96p. (CE—01571). CANMET/TID, Energy, Mines and Resources Canada, 555 Booth St., Ottawa, Ont., Canada K1A 0G1; $0.34CAN per page, $3.40 CAN minimum.

While various energy cascading equipment and techniques such as heat exchangers, district heating and cogeneration are well developed and often used by industry, a relatively moderate progress has been made in developing a new energy cascading concept by chemical heat pump system in recent years. In the course of this study, it was discovered that chemical heat pumps can provide unusually effective solutions to certain heat upgrading problems in industry, possibly including the process of material drying by air. Implementation of this concept in Canadian paper manufacturing was reviewed. Among many chemical heat pump techniques developed today, gas-liquid heat pumps using sulphuric acid or caustic soda fluid as absorbent have been advanced and utilized in pilot projects. Studies further indicated that utilizations of this type of pump for energy recovery in paper manufacturing are beneficial to the industry and technically feasible. Based on the results of the

economic analysis of a typical demonstration project, this study suggests that chemical heat pump energy recovery projects of this kind are only marginally viable to the industry in today's economic climate. Capital cost assistance of any kind will undoubtedly improve the financial feasibility significantly and likely become necessary in order to attract demonstration project participants. The potential for chemical heat pump application in Canadian industry is reviewed and assessed. It is estimated that approximately 12.8 gige cal/y, equivalent to about 8.5 million barrels of oil per year, are technically recoverable from rejected waste heat streams by using chemical heat pump systems in Canadian industry as a whole. 23 refs., 11 figs., 22 tabs.

43425 **(BUR—17) Catalytic/recuperative incinerator pilot plant investigation. Final report.** Paskall, H.G.; Ritter, R.A.; Dale, P.R. (Bow Valley Research Ltd., Calgary, Alberta (Canada)). Jun 1985. 96p. (CE—01557). CANMET/TID, Energy, Mines and Resources Canada, 555 Booth St., Ottawa, Ont., Canada K1A 0G1; $0.34CAN per page, $3.40 CAN minimum.

A pilot scale catalytic/recuperative heat exchange incinerator was constructed and evaluated, on-site, at an Alberta sulphur plant. A blend of waste gas, air and fuel was directed through the shell of a heat exchanger for preheating then caused to flow through the catalyst bed where the oxidation of the combustible components provided the heat required to maintain the catalyst bed temperature. The oxidation products emerging from the combustion chamber were then passed through the heat exchanger tubes and, ultimately, discharged. The test program was designed to characterize the performance of the incinerator at four catalyst bed temperatures. Particular attention was devoted to the precise measurement and control of all variables required to define the material and energy balances and, hence, the energy efficiency of the system. The quality of the data obtained from the pilot plant study was excellent and indicated the following. The oxidation reactions are generally progressive throughout the shell and combustion zone of the incinerator. Predicted heat transfer coefficients in the heat exchanger deviated widely from those determined experimentally. The formation of SO/sub 3/ was kinetically limited at low catalyst bed temperatures, but the stack gas concentration was unacceptably high. At temperatures around 900/sup 0/C, the SO/sub 3/ concentration was near the equilibrium value, and the stack concentration was at a more acceptable level. The catalytic/recuperative incinerator concept appears to offer a practical means to limit energy consumption in sulphur plant waste gas incineration. Savings could be in the order of 30% to 100% when compared to the conventional incinerator configuration. 6 refs., 28 figs., 12 tabs.

43426 **(CCE—20121985) Heat recovery in a meat packing plant. Report on stage 1: design and pricing.** (Crawford Consulting Engineering Ltd., Calgary, Alberta (Canada)). 20 Dec 1985. 30p. (CE—01559). CANMET/TID, Energy, Mines and Resources Canada, 555 Booth St., Ottawa, Ont., Canada K1A 0G1; $0.34CAN per page, $3.40 CAN minimum.

The objective of this project is to reduce the cost of purchased utilities by recovering about 25% of the heat rejected by the refrigeration system in an Alberta meat packing plant. The heat would be recovered and used to preheat cold water that is heated by steam for use in the slaughtering process. This report describes all the design and planning to date on this project with a review of the expected economics. The work done includes a report of the research which summarizes the technology and applications to date and points out that the technology is tried and proven and the hardware is readily available. However, the application of this technology is little used in meat processing plants in Alberta. Reports of other installations had little data to prove actual results over the projects as designed. The original design was reviewed and refined, and the heat exchanger selected for the maximum economic recovery of heat from the ammonia compressor. This worked out to be approximately 30% of the heat. Piping schemes were decided upon and the monitoring and indicators were selected as to the kind and locations for best results for future study. Drawings and specifications were produced and sent out to a contractor for pricing. The prices came in over budget as it was decided to use better materials for the heat exchangers and also a better monitoring scheme than had been originally envisioned. The budget is now considered as final for the construction of the project and has been accepted as achievable by all parties. The payback period target is under the two-year target, with better payback possible in the event of two shift production. 15 refs., 5 figs., 1 tab.

43427 (CONF-871075—Vol.1-Pt.3, pp 291-301) **Recovery of zinc, iron, and sulfur from galvanizer wastes.** Trimm, J.R.; Stumpe, L.A.; Tomaszewski, T.M. (Tennessee Valley Authority, Muscle Shoals, AL (USA)). 1987. NTIS, PC A18/MF A01. Order Number DE88007805/JAW.

From 3. Oak Ridge model conference on waste problems; Oak Ridge, TN, USA (13 Oct 1987).

At TVA's National Fertilizer Development Center in Muscle Shoals, Alabama, researchers are engaged in essentially all areas of fertilizer research. Included in this research is the recovery of plant nutrients from material which would normally be considered waste, particularly toxic or hazardous wastes. Agronomists generally classify fertilizers according to three categories: the primary nutrients - nitrogen, phosphorus, and potassium; the secondary nutrients - calcium, magnesium, and sulfur; and the micronutrients - zinc, boron, cobalt, iron, manganese, copper, sodium, and molybdenum. Whereas the need for primary nutrients has been known for decades, the acute need for micronutrients has become apparent only in recent years. Land, in many cases, that has been farmed for relatively long periods of time and fertilized with proper amounts of the primary nutrients has become deficient in some of the secondary and micronutrients. In order to restore optimum yields, the level of these nutrients must be brought to acceptable levels.

43428 **(DOE/BP/92222—1) Reduction in mill air compressor power requirements through installation of a variable frequency speed control.** (Georgia-Pacific Corp., Toledo, OR (USA). Toledo Paper Div.). Mar 1988. Contract MS79-86BP92222. 67p. NTIS, PC A04;3. Order Number DE88008493/JAW.

A variable frequency drive system was installed to enable variable speed control of one of the mills 1000 hp rotary screw air compressors. Prior to this installation, control was achieved by a combination of recycling low pressure stage air, bleeding air to the atmosphere and bag plant and by loading and unloading the compressors. This method of control was costly in energy usage and in equipment wear and tear. This installation has eliminated the need to bleed off air and load and unload the compressors and has greatly reduced the recycle. It has resulted in a 20% savings in mill air compressor power usage (2.119 million KWH annually) and a 33% reduction in mill air pressure variation. The turndown on variable speed is limited by the intercooler pressure and at a minimum 53% speed is less than expected. Although the total energy saved is double the original projection due to an unexpected decrease in total air demand, only 77% of the projected savings were realized in the areas expected. 13 figs., 8 tabs.

43429 **(ECRC/M—2231) Influence of charge and lining characteristics on copper melting in a medium frequency coreless induction furnace.** Smith, L. (Electricity Council Research Centre, Capenhurst (UK)). Mar 1988. 34p. Electricity Council Research Centre, Capenhurst, Chester, CH1 6ES, UK.

The choice of lining material is known to have a significant influence on the melting of copper in medium frequency furnaces. To date, there has been a shortage of data which systematically compares melting performance in conducting and non conducting linings or examines the influence of charge materials. This report uses data obtained from melting trials carried out as part of the Metal Melting service to Area Boards provided by the Capenhurst Laboratories of the Electricity Council. The ability to monitor electrical parameters throughout a melting cycle has enabled melting performance data to be better analysed than hitherto. A range of energy consumptions are presented for different combinations of linings and charge type. The use of a preformed silicon carbide crucible provides the most efficient approach although attention is drawn to the possibility of generating undesirably high crucible temperatures.

43430 (ECRC/R—2240) Energy saving in paper drying through steam compression. Benstead, R.; Hodgett, D.L. (Electricity Council Research Centre, Capenhurst (UK)). Feb 1988. 10p. Electricity Council Research Centre, Capenhurst, Chester, CH1 6ES, UK.

The major energy demand in the manufacture of paper and board is the drying. An analysis has been made of two paper machines to see what contribution steam compression could make to further reduce their energy consumption. The heat and mass balance of one of these machines, which is one of the most energy efficient in the U.K., is described and the possibilities for steam compression discussed. A process integration study is then used to see the effect of these on the machine heat balance.

43431 (EMR—18) Energy conservation in the plastic processing industry in Canada. Love, L.E. (Department of Energy, Mines and Resources, Ottawa, Ontario (Canada)). Feb 1983. 324p. (CE—01731). CANMET/TID, Energy, Mines and Resources Canada, 555 Booth St., Ottawa, Ont., Canada K1A 0G1; $0.34CAN per page, $3.40 CAN minimum.

The Canadian plastics processing industry is comprised of approximately 1,800 mostly small-sized firms who mold, extrude, shape or fabricate plastic resin into finished products or component parts. The industry was perceived to have good potential for energy conservation. However, only a low percentage of firms were reporting to the task force involved. It was felt a study of this situtation would disclose the reasons for the reluctance of the processors to involve themselves in energy conservation and would present the opportunity to estimate the potential energy savings for the future. The survey showed two main causes for this reluctance. Most small or medium size firms perceive that a program would take too much time and would require too great a capital investment. Those firms which have tried a program seriously have found this not to be the case. Estimates show that about 3/4 of the potential savings of 25%, on an annual basis for 1984, comes from procedural methods, or by capital expenditure with less than two years pay-back. The other aspect that arises is the relatively low percentage cost of energy compared to other manufacturing costs involved in plastic processing. Information on conservation techniques including new energy efficient designs and methods, is presented. The final estimate of possible energy conservation in the industry amounts to nearly 4 million GJ for 1984. This report also develops a guide to assist processors in developing energy saving programs. This is a simple, inexpensive approach relevant to the size of the majority of processors in Canada. A number of technical article reprints are included for easy reference. These deal with the new energy efficient machines and they also outline, in detail, methods of conservation that processors can use in their operations. 9 figs., 14 tabs.

43432 (KEE—111985) Conceptual report for waste heat recovery from the refrigeration unit at the Okotoks Triplex Arena. (Kasten Eadie Engineering Ltd., Edmonton, Alberta (Canada)). Nov 1985. 37p. (CE—01652). CANMET/TID, Energy, Mines and Resources Canada, 555 Booth St., Ottawa, Ont., Canada K1A 0G1; $0.34CAN per page, $3.40 CAN minimum.

The waste heat available from artificial ice rinks in Alberta is large, shown in this report to be about 1,344,000 GJ/y of low grade heat and 255,360 GJ/y of high grade. Most current applications for using high grade heat are for water heating, and in some cases low grade heat is also used for ice arena heating. In this project, it is proposed to use high grade waste heat from an ice rink in Okotoks, Alberta to heat a swimming pool currently heated by natural gas. The facility in which the project is located has three rinks, swimming pool and whirlpool, and the refrigeration plant uses two compressors. An energy audit was completed to show waste heat production and pool heating requirements, and two conceptual designs for utilizing the waste heat are presented. Potential cost savings over natural gas heating are estimated at $5,426/y. The project cost estimate is $29,488 implying a simple payback period of 5.4 years. This can be reduced further in the piping and instrumentation areas in this and other commercial projects of a similar nature. Completion date for the project is estimated as June 1987. 10 refs., 3 figs., 5 tabs.

43433 (MU/ME—051982) Westward Mall performance analysis. (Manitoba Univ., Winnipeg (Canada). Dept. of Mechanical Engineering; Manitoba Dept. of Energy and Mines, Winnipeg (Canada). Conservation and Renewable Energy Branch). May 1982. 45p. (CE—01593). CANMET/TID, Energy, Mines and Resources Canada, 555 Booth St., Ottawa, Ont., Canada K1A 0G1; $0.34CAN per page, $3.40 CAN minimum.

The Portage Curling Rink and Westward Village Inn complex in Manitoba incorporated many energy conservation features. The complex included a curling ring, from whose ice plant heat was recovered and used to supplement the space heating of the complex. Summer cooling was achieved by the use of ground water at an average temperature of 12/sup 0/C. Four storage tanks were incorporated into the basement of the complex to store cold and hot water. The DOE-2 computer program was used for modelling of building energy consumption and the evaluation of the effect of the special features on energy utilization. The major features that were modeled were the heat recovery and cooling systems. The results of the analysis indicated that the existing complex had an energy consumption index of 1,046 MJ/m/sup 2//y, while the estimated requirements of a complex of conventional design and equal size were 1,330 MJ/m/sup 2//y. The recovered energy from the ice-making plant provided 45.6% of the space heating requirements of the complex, and the use of ground water provided almost free cooling. Heat recovery systems for venitilation exhaust were also evaluated. A solar system for air preheating with 185 m/sup 2/ of panel was simulated by the computer model which integrated it with the existing air handling system. The model indicated that it would save $1,240/y with an estimated initial cost of between $20,000 and $30,000. The replacement of the natural gas heating plant by an electric boiler was simulated and resulted in an energy saving but at an increased cost. 6 refs., 7 figs., 5 tabs.

43434 (NEI-DK—68) Prelimenary investigations of the hardening qualities of desulphurization products. The deculphurization product stabilisat. Soerensen, J.L.; Foged, N.; Henriksen, P.; Gram Jeppesen, K. (Geoteknisk Inst., Lyngby (Denmark); Danmarks Tekniske Hoejskole, Lyngby. Inst. for Mineralindustri). Jul 1986. 34p. (In Danish). NTIS (US Sales Only), PC A03/MF A01. Order Number DE88752082/JAW.

Roeggasafsvovling paa danske kraftvaerker.

In order to prove the hypothesis that hardening of a desulphurizatio product containing fly ash is a thermal activated process which follows the Arrhenius equation, this report investigates the possibility of carrying out accelerated testing as it is known with fly ash. The product used for this project is stabilisat which consists of fly ash and pure desulphurization product in the mixture 35% to 65%. The development of strength is the cylindrical tests wit the product stabilisat is investigated by factor analysis, because i is tried to be established that the ultimate strength is dependent upon temperature and curing. The development of strength prove very clearly that the hardening process in the desulphurization product i thermal activated. The mineralogic investigations show a tendency to better crystallization at higher temperatures and an increased formation of one-step lattice. The x-ray diffraction analyses show that the three active components in the dry desulphurization product calcium hydroxide, calcium aluminate glass and calcium sulphite hemihydrate react very different at the three tested temperatures. A 5 deg. C mostly carbonatization, at 20 dec. C the puzzolane reaction are evident and at 40 deg. C the speed of reaction is higher. (SM).

43435 (NP—8770253) Recycling of battery brownstone. Pfeiffer, T. (Goettingen Univ. (Germany, F.R.)). 5 Feb 1987. 90p. (In German). NTIS (US Sales Only), PC A05. Order Number DE88770253/JAW.

The author analyzed three processes for treating brownstone from spent, Mg-O-containing batteries. Wet chemical processing in H/sub 2/SO/sub 4/ resulted in a gamma-MnO/sub 2/ with an oxidation rate > 1.95 at a discharge capacity of 280 mAh/g. The Hg concentration of the product brownstone was reduced to < 0.05% by adding chlorate to the acid. Drawbacks are the low bulk weight of MnO/sub 2/ and the acid product solution which contains Fe, Hg, Zn, and K which requires further processing. In the second

process, the battery mass was separated into manganese/graphite and zinc in a fluidized bed with SO/sub 2//air/gas mixtures. Mercury is expelled at reaction temperature. In the third process, slurries of battery material and water were converted in a wet chemical process by blowing SO/sub 2//O/sub 2/ (air) gas mixtures into the slurry. The products were coarse-grained and similar to the fluidized-bed products except for the lower MgO/sub 2/ oxidation rate. Here, too, an acid solution containing metal ions was obtained . (orig./MM)

43436 **(RA—30031984) Application of a heat pump in the pulp and paper industry.** (Robb (G.A.) Associates, Ottawa, Ontario (Canada)). 30 Mar 1984. 90p. (CE—01563). CANMET/TID, Energy, Mines and Resources Canada, 555 Booth St., Ottawa, Ont., Canada K1A 0G1; $0.34CAN per page, $3.40 CAN minimum.

The development and demonstration of a steam generating heat pump using R114 refrigerant is proposed. The thermal output should be roughly 16 GJ and the steam pressure between 34 and 69 kilospascals. The heat pump should be suitable for water sources in the 55 to 85/sup 0/ C range. The demonstration installation would use water heated by steam from a thermo mechanical pumping system. This will provide flexibility in terms of source temperature without influencing the pulp and paper process. The most important application would be heat recovery from white water from mechanical pulping processes. There are many other potential applications in the pulp and paper and other industries. This heat pump, with a steam compressor, would allow upgrading of large quantities of heat from mechanical pulping in newsprint mills, boiler flue gas scrubbers, pulp and paper machine dryer hoods and other sources for use as process steam. The alternatives considered were a large scale R114 steam generating heat pump and a binary R114-methanol system. The heat pump proposed can be engineered and built by Canadian firms. Cost estimates, profitability analysis along with a sensitivity analaysis are included. This technology can displace 5.4 million bbls of oil equivalent annually in the newsprint industry alone. 7 figs., 5 tabs.

43437 **(Y/DV—662) Replacement of chlorinated solvents at the Oak Ridge Y-12 plant.** Thompson, L.M.; Simandl, R.F.; Richards, H.L. (Oak Ridge Y-12 Plant, TN (USA)). 30 Sep 1987. Contract AC05-84OS21400. 14p. NTIS, PC A03/MF A01; 1; GPO Dep. Order Number DE88012906/JAW.

Due to environmental and helath concerns, both EPA and OSHA have announced their intent to futher restrict the use of chlorinated solvents. In order to comply with these upcoming regulations, the Oak Ridge Y-1 Plant is conducting a survey on the use of these solvents and possible alternatives. The main use of these solvents has been found to be for cleaning purposes. This includes vapor degreasing as well as squirt bottle usage for removal of machining oils and coolants. One alternative which has been successful is the use of ultrasonic cleaning with aqueous detergents. Several studies have been conducted using X-ray Photoelectron Spectroscopy (XPS/ESCA) to evaluate the surface cleanliness and the effect of this cleaning technique on the surface chemistry. Studies have also been conducted to optimize various factors which influence this cleaning technique. Although this technique has been useful in several areas, some problem areas still exist with replacing chlorinated solvents. These areas are currently being addressed and will continue to be addressed in the future. 2 refs., 4 figs., 1 tab.

3206 Municipalities And Community Systems

REFER ALSO TO CITATION(S) 43034, 43592

43438 **(AA—31031982) Feasibility report on implementing automatic process control at a municipal wastewater treatment plant to demonstrate energy conservation and improved operation.** (Anderson Associates Ltd., Willowdale, Ontario (Canada)). 31 Mar 1982. 252p. (CE—01585). CANMET/TID, Energy, Mines and Resources Canada, 555 Booth St., Ottawa, Ont., Canada K1A 0G1; $0.34CAN per page, $3.40 CAN minimum.

This study covers the results of two separate sub-studies at seven existing municipal wastewater treatment plants in southern Ontario. One sub-study consisted of a review and evaluation of four wastewater treatment plants with the purpose of assessing suitability and selecting one for the implementation of a full-scale research demonstration program to demonstrate energy conservation through automatic control of dissolved oxygen and sludge inventory. The objectives of this sub-study were to select a wastewater treatment plant which is capable of being segregated into two equal, parallel aeration/final settling process trains, to determine retrofit requirements at the selected plant based on operating and monitoring the two parallel process trains, to achieve automatic control and data logging through a real-time computer control system, and to prepare appropriate control cost estimates for retrofitting the selected plant. The second sub-study had similar objectives and consisted of a more generalized review and evaluation of three additional plants for the purpose of assessing their suitability and selecting one for the implementation of a full-scale demonstration of automatic control of sludge conditioning and dewatering via sludge viscosity control. In the first sub-study, the Barrie plant was selected as capable of being retrofitted to complete automatic control of dissolved oxygen and sludge inventory. In the second sub-study, the Duffin Creek plant was found to be easily adaptable to retrofitting and was recommended for automatic polymer feed control through viscosity sensing. 67 figs., 61 tabs.

43439 **(DOE/CE/26551—T1) Assessment of the potential of using district heating and cooling systems in Newark, New Jersey. Phase I. District heating and cooling assessment program. Final report.** (Trigen Energy Corp., New York (USA)). [1988]. Contract FG01-86CE26551. 87p. NTIS, PC A 05; 3; GPO Dep. Order Number DE88012289/JAW.

Objectives included: thermal market identification and development; identification of potential heat sources; evaluation of potential transmission/distribution network configurations; conceptual design and analysis of central plant options; economic feasibility of developing and operating a DHC system; analysis of financing options; and identification of the legal, regulatory, and institutional issues. Technically, it was concluded that a DHC system is feasible for the central business district of Newark, however: (1) the system must offer cooling as well as heating; (2) the medium should be steam at 150 psi or higher, and (3) no adequately sized thermal plants are available for leasing. Economically, the project is considered feasible, but (a) boiler-only plants are not economic; (b) new cogeneration is uncertain; and (c) electric sales are needed as well as heating and chilled-water sales. System-wise, the preferred system should be based on refuse, which has the fewest hurdles and mostly tax-exempt financing.

43440 **(KFK—4379) Formation and decomposition of polychlorodibenzodioxins and -furans in municipal waste incineration.** Stieglitz, L.; Vogg, H. (Kernforschungszentrum Karlsruhe G.m.b.H. (Germany, F.R.). Lab. fuer Isotopentechnik; Kernforschungszentrum Karlsruhe G.m.b.H. (Germany, F.R.). Inst. fuer Heisse Chemie). Feb 1988. 21p. NTIS (US Sales Only), PC A03/MF A01. Order Number DE88753783/JAW.

Results on the formation and decomposition of polychlordibenzodioxins (PCDD) and -furans (PCDF) in municipal waste incinerators are summarized. Experimental data on the formation conditions of PCDD/PCDF on fly ash are reported. Essential parameters for formation are the temperature range (300/sup 0/C), the reaction time, the presence of oxygen and of water vapor in the gas phase. The source for PCDD/PCDF are active carbon particulates in the fly ash which react with inorganic alkali/alkaliearth chlorides under participation of metal salts such as copper(II) chloride. The influence of carbon content and the concentration of copperchloride on PCDD/PCDF formation is shown. Data on the decomposition of PCDD/PCDF in fly ash prove the technical feasibility of dioxin/furan degradation at low temperatures in air and in inert atmosphere as well. (orig.)

43441 **(LUSG-WP—496) Local energy conservation initiatives in the U.K.: their nature and achievements.** Sheldrick, B.; Macgill, S. (Leeds Univ. (UK). School of Geography). Aug 1987. 50p. British Library Document Supply Centre, Boston Spa, Wetherby, West Yorks. LS23 7BQ.

A report is given of five local energy conservation initiatives in the UK at Glasgow, Newcastle, Lewisham, Hackney and Cardiff. A systematic comparative evaluation is performed on the nature and achievements of these schemes. Conclusions are presented on improving the effectiveness and wider application of such local energy conservation initiatives.

43442 **(MA—RR3) Materials flow through the household and reduction in domestic solid waste.** (Middleton Associates, Toronto, Ontario (Canada)). May 1975. 136p. (CE—01620). CANMET/TID, Energy, Mines and Resources Canada, 555 Booth St., Ottawa, Ont., Canada K1A 0G1; $0.34CAN per page, $3.40 CAN minimum.

Energy conservation programs are usually designed to reduce the waste associated with direct energy use for example, heating and lighting levels, and use of appliances. But householders can also influence energy consumption in other sectors. Their buying and consuming habits will affect the energy involved in extraction, production, transportation, use and disposal of commodities. Their attitudes and behavior will affect their neighbours' efforts at reducing materials throughput. Therefore, the household must be an important target in any effort to alter energy use patterns throughout society. The purpose of this study was to determine whether practical programs could be developed to reduce materials flows through the hosuehold. Since solid waste output is a very reliable measure of these flows, the question was posed from the perspective of reducing the generation of residential solid waste. In this context particular attention was given to the range of possible actions open to the householder himself. It would have been unrealistic, however, to ignore environmental design and other legislative options. The study is divided into three parts. The first attempts to identify those actions by the householder which will have the greatest effect in reducing the total environmental impact (including energy use) of the materials moving through the household. The second deals with the problem of persuading people to engage in these actions. The final part combines promising strategies with significant actions. The result is a series of program options which are assessed with respect to four criteria: potential significance for residential solid waste reduction, chances of success, ease of implementation, and costs. 15 refs., 7 figs., 3 tabs.

43443 **(MC—15) The realistic potential for district heating in Canada. 2 Vols.** (Monenco Consultants Ltd., Rexdale, Ontario (Canada)). Apr 1985. 550p. (CE—01659). CANMET/TID, Energy, Mines and Resources Canada, 555 Booth St., Ottawa, Ont., Canada K1A 0G1; $0.34CAN per page, $3.40 CAN minimum.

In view of the energy conservation and other benefits associated with district heating and the limited acceptance that the technology has enjoyed in Canada, a study was commissioned to establish the realistic potential for its development. Detailed study is presented of current literature and practice, historical aspects of district heating in Canada and Europe, technical aspects of the various types of energy supply systems, transmission and distribution networks, and subscriber heating systems, potential sites for Canadian systems, and economic, social, environmental, and governmental factors. The study has indicated that district heating can be competitive with conventional heating alternatives in some segments of the Canadian space heating market. However, the proportion of the space heating market in which the technology can be competitive is highly dependent on the amount of cross-subsidization and the level of market penetration. The study considered the feasibility of district heating in urban centers with a total population of about 13 million. With cross-subsidization of lower density heat loads in these centers by the high density heat loads, and 100% market penetration in areas where it is competitive, it is estimated that district heating could economically supply up to 50% of this requirement. A reduction in market penetration to 50% is estimated to reduce the economic potential for district heating by about 80% due to lost economies of scale. It is unlikely that district heating could achieve high levels of market penetration without the significant support of all levels of government. 265 refs., 76 figs, 119 tabs

43444 **(NEI-DK—67) Reduction of supply temperature during the night, project P44.1. Supplementary report.** (Cowiconsult Raadgivende Ingenioerer A/S, Virum (Denmark)). Aug 1987. 186p. (In Danish). NTIS (US Sales Only), PC A09/MF A01. Order Number DE88752081/JAW.

Temperature in a district heating system will change dependent on th production, consumption and heat loss. An accurate description of th dynamical temperature conditions can only be made with use of advanc computer models. For more general analyses it will usually be enough with simplified descriptions of the dynamics. In this supplement a series of such simplifications, are presented which have been the basic for analyses in other parts of the report. In the chapter A2, linear systems some general and theoretical derivations are made for use in future analyses. (SM).

43445 **(NP—8770254) Hydrometallurgical separation of heavy metals from slurries.** Rossel, H. (Technische Univ. Berlin (Germany, F.R.). Fachbereich 17 - Werkstoffwissenschaften). 16 Jan 1987. 151p. (In German). NTIS (US Sales Only), PC A08. Order Number DE88770254/JAW.

The extraction of Pb, Cd, Cu, Cr, Ni, und Zn from municipal sewage sludge and excavated earth was investigated in order to find out whether the heavy metal concentrations can be reduced to a level where the sludges can be used as agricultural fertilizers. It was found that nonferrous metals can be mobilized by acid, oxidizing leaching and separated by a solid/liquid separation process. The most efficient oxidant is ferric chloride which can be regenerated by reoxidation and thus enables circulation of the alkaline solution. This will lower the cost of the process. The dissolved nonferrous metals can be separated by a sulfide precipitation process. Four different process variants were compared with regard to their cost. (orig./EF)

43446 **(STW-RP—87-082) Recovery of power in water distribution systems.** Thorp, G.H.; O'Neill, K.J. (Severn-Trent Water, Birmingham (UK)). 1987. 24p. British Library Document Supply Centre, Boston Spa, Wetherby, West Yorks. LS23 7BQ.

Hydrogenerators have been in existence for many years and used in many industries from electricity supply through to paper making and aluminium smelting plants. Turbines are available which will cope with fluctuating heads, guide vanes being used to direct the flow through the turbine. The majority of turbines are shaft coupled to generators which produce electricity either independently or in parallel with the Electricity Board's supply network, the majority being operated independent of the Board's network. Water Authorities' use of hydrogenerators in the past has been limited because of the high capital cost of purpose-designed water turbines, and the relatively low cost of energy in the past compared with present day tariffs. The recent introduction of the submersible generator with its low capital cost and ease of installation will make many previously uneconomic schemes viable.

3209 Education And Public Relations

REFER ALSO TO CITATION(S) 43394, 43442

43447 **(BCU—021979) Overview topic paper on mass media energy conservation communications.** Vertinsky, P.; Vertinsky, I. (British Columbia Univ., Vancouver (Canada)). Feb 1979. 67p. (CE—01610). CANMET/TID, Energy, Mines and Resources Canada, 555 Booth St., Ottawa, Ont., Canada K1A 0G1; $0.34CAN per page, $3.40 CAN minimum.

The utilization of information diffusion strategies to increase energy conservation knowledge and practices among the general population in Canada is discussed in terms of 5 media functions: information dissemination, remedial behavior modification, lifestyle decisions, initiating conservation action, and crisis management. Each of these functions is critically addressed in terms of media mix, message content and form, timing and intensity, exposure, and specific target populations. The diffusion strategies are then organized into a matrix of policy options to enable the appropriate one to be selected. Four major categories of energy conservation infor-

mation considered are the nature of the energy problem, methods of conservation, results of conservation, and the individual consumer decision-making process. Heavy television exposure suggests this medium has enormous potential for informing Canadians on conservation issues. Print seems to be the main source of detailed, specialized, and sophisticated kinds of information. However, despite wide media availability, large numbers of the population consistently escape contact with widely reported information. Behavioral modification to change undesirable energy habits is examined from the perspectives of initial change and cultural/social change required to sustain new lifestyles. The use of mass media during crisis situations may be of essential importance for implementation of future energy policies. Information dissemination and responses to the mass media do not appear to have the same patterns during crisis and non-crisis situations. 279 refs.

43448 **(CCA—1979) Leisure activities and energy consumption. A review.** Ritchie, J.R.B. (Consumer and Corporate Affairs Canada, Ottawa, Ontario). 1979. 62p. (CE—01605). CANMET/TID, Energy, Mines and Resources Canada, 555 Booth St., Ottawa, Ont., Canada K1A 0G1; $0.34CAN per page, $3.40 CAN minimum.

This paper attempts to review the leisure behaviour of consumers as it pertains to energy consumption and conservation in the Canadian setting. Literature review reveals that the study of leisure activities in an energy context has been largely ignored. As a result, it was necessary to propose a new paradigm for classifying the energy consumption components of leisure activities into direct, indirect, maintenance and travel elements. This paper has also made an extensive review of the literature pertaining to the benefits derived from leisure activities. A number of physical and psychological barriers to moving individuals from high to low energy consumption activities were subsequently identified. A philosophy and a list of specific objectives for further research were outlined. Some important preliminary conclusions are as follows. A great number of leisure activities appear to require relatively little energy for their performance, greater participation in these activities offers an attractive mode of energy conservation. Leisure activities which include or require travel appear to represent the most serious drain on energy resources. Strategies for reducing energy consumption with regards to such activities will need to focus on efforts to reduce participation levels in these types of activities, switch travellers to more efficient travel modes, and encourage more efficient use of existing travel modes. A number of leisure activities require the construction and maintenance of large, energy intensive facilities for their performance. To date, it is not clear that much effort has been made to ensure their energy, efficient construction and use. 79 refs., 6 tabs.

43449 **(CCA—121982) Consumer energy management: policy implications of research. 2 Vols.** McDougall, G.H.G.; Ritchie, J.R.B. (Consumer and Corporate Affairs Canada, Ottawa, Ontario). Dec 1982. 135p. (CE—01600). CANMET/TID, Energy, Mines and Resources Canada, 555 Booth St., Ottawa, Ont., Canada K1A 0G1; $0.34CAN per page, $3.40 CAN minimum.

This report provides a framework for understanding the practical implications of consumer energy conservation research in Canada. A review of such research was undertaken to determine its implications for increasing the effectiveness of Canadian conservation policies and programs. The major conclusions and recommendations were as follows. Conservation has been acknowledged as the single most important element in solving Canada's petroleum shortfall in the 1980s. An analytic approach to the formulation of energy policies and the design of conservation programs will be essential if meaningful energy savings in the consumer sector are to be realized. Prior to designing any conservation program, it is essential that the components of consumer energy policy be understood. In order to assess the effectiveness of conservation efforts, it is necessary to assign relative priorities to the criteria of probable energy savings, cost effectiveness, impact by fuel type, impact on consumers, enforceability, and institutional considerations. Conservation efforts aimed at consumers must be based on understanding the basic processes which underlie how they perceive and respond to various types of conservation initiatives. This understanding is gained through consumer impact analysis and program research. The latter action attempts to analyze the effectiveness and acceptability of programs involving information, financial incentives, energy standards, and energy usage restrictions. Conservation programs must ensure that barriers to adoption, such as lack of time and knowledge, financial resources, and lifestyle impacts, will be minimized. 93 refs., 3 figs., 13 tabs.

43450 **(CU—1980) Leisure satisfaction and energy conservation.** Ritchie, J.R.B.; Claxton, J.D.; Vosburgh, R.E. (Calgary Univ., Alberta (Canada); British Columbia Univ., Vancouver (Canada); Guelph Univ., Ontario (Canada)). 1980. 96p. (CE—01606). CANMET/TID, Energy, Mines and Resources Canada, 555 Booth St., Ottawa, Ont., Canada K1A 0G1; $0.34CAN per page, $3.40 CAN minimum.

The focus of this research concerns the relationships among the factors which influence decisions to participate in the broad range of leisure activities which are available to members of a developed industrial society, and the factors which influence the amount of energy consumed by individuals in such a society. Within these parameters, the overall purpose of the study is to understand the nature of human satsifactions derived from a representative set of leisure activities which consume various amounts of energy. An initial assessment was made of the extent to which low energy consuming activities might be substituted for high energy consuming activities without a significant loss in the level or type of satisfaction sought by individuals. To achieve this purpose, a survey was conducted in 3 Canadian cities to obtain a range of measures on attitudes, satisfactions and behaviours for a set of 24 leisure activities. A general set of conclusions was reached which may be helpful for the formulation of consumer energy policies. It would appear that time devoted by consumers to levels of energy consumption, and that the most preferred activities were those that had low energy consumption levels. There appears to be considerable opportunity to increase participation in certain low-energy-intensity activities by identifying and minimizing the barriers to participation. Such attempts should recognize the relative importance of the various satisfactions sought by participants. 38 refs., 4 figs., 9 tabs.

43451 **(DR—041982) An initial evaluation of the Canada oil Substitution Program: converter and nonconverter profiles.** (Decision Research Ltd., Winnipeg, Manitoba (Canada)). Apr 1982. 169p. (CE—01594). CANMET/TID, Energy, Mines and Resources Canada, 555 Booth St., Ottawa, Ont., Canada K1A 0G1; $0.34CAN per page, $3.40 CAN minimum.

This study was designed to provide an initial evaluation of the impact of the new Canada Oil Substitution Program (COSP) on off-oil conversion decisions. Detailed questionnaires were mailed to COSP converters and nonconverters and a selected list of findings from this study follows. Differences between the two groups' general energy views were quite small, although converters were slightly more positive. Insulation was viewed as the best energy saving approach by both. Both groups ranked the fear of future oil prices as the primary reason for converting or considering conversion. Nonconverters were most likely to suggest that satisfaction with their present oil heating system was the greatest barrier to converting. Nearly half the nonconverters strongly agreed that they could not afford to convert, even with financial assistance. Middle income respondents tended to be the most energy conscious and the most likely to convert. Most nonconverters were aware of COSP, and such awareness increased with education and income. The main feature of COSP disliked by both groups was the fact that grants had to be treated as income for tax purposes. Personal, direct sources of COSP information were the most effective means of communicating COSP information. About 60% of converters appeared to have converted sooner than they would have otherwise done had COSP not been available. Just over 50% of converters who could have been impacted by COSP were not impacted. Availability of COSP is associated with a high conversion probability among nonconverters. 76 tabs.

43452 **(EMR/OEC—RR5) An examination of measures designed to encourage energy conservation from the perspective of motivation theory.** (Department of Energy, Mines and Resources, Ottawa, Ontario (Canada). Office of Energy Conservation). Oct 1975. 35p. (CE—01614). CANMET/TID, Energy, Mines and Resources Canada, 555 Booth St., Ottawa, Ont., Canada K1A 0G1; $0.34CAN per page, $3.40 CAN minimum.

This report addresses itself to the insights offered by the psychology of motivation to those wishing to encourage the conservation of energy. After an extensive review of the relevant literature, it was found that the bulk of the psychological literature offers little that can be adapted for immediate practical application to a large scale motivational campaign. There are, nevertheless, some well-supported conclusions that can be drawn from the theory and experimentation of psychology that are of direct relevance to the efficient and effective planning and execution of a campaign to encourage conservation of energy. This report addresses itself to these conclusions. The contents of the report include comments on the efficacy of various types of programs, the conditions under which those programs are most likely to succeed, and the critical elements which should be included in those programs if they are to exert their maximum effect. These types of programs include intrinsic and extrinsic motivation, i.e. creating new behavior patterns with internally or externally generated rewards, fear inducement (threats of energy shortages), and cogenitive dissonance, involving images of oneself and one's cultural environment. 66 refs.

43453 **(QU—1984) Energy cost indicator demonstration program. A report on Canadian and United States field experiments.** Filiatrault, P.; Hutton, R.B.; Mauser, G.A. (Quebec Univ., Montreal (Canada); Simon Fraser Univ., Burnaby, British Columbia (Canada); Denver Univ., CO (USA)). 1984. 75p. (CE—01572). CANMET/TID, Energy, Mines and Resources Canada, 555 Booth St., Ottawa, Ont., Canada K1A 0G1; $0.34CAN per page, $3.40 CAN minimum.

This report presents the results of four field experiments, two in Canada and two in the United States, which examined homeowners' use of an electronic feedback device, the Energy Cost Indicator (ECI), over a one-year period. This is the first large-scale study of the impact of feedback on energy consumption involving both representative samples of homeowners and long-term use of a feedback device. The objectives of the study were to measure changes in: home consumption of natural gas and electricity, individual awareness of and attitudes toward energy conservation, and energy conservation activities. In both of the Canadian test sites (Montreal and Vancouver), ECI households were found to use significantly less energy than households in other conditions. Savings ranged from 3.5% to 5.1% of annual household energy consumption. The Education condition did not differ significantly from the controls in either city. No significant differences were found in either of the field experiments in the United States. Attitudes toward the ECI were extremely positive, despite widespread mechanical difficulties with the device. Respondents said the ECI helped them conserve energy by increasing their awareness of what uses energy and by motivating them to conserve because they could see costs mounting. The conservation activities reported most frequently be ECI respondents were setting back the temperature on the water heater, setting a lower temperature on the washer, keeping the lights off when one is not in the room, and turning the household thermostat down at night. 4 figs., 40 tabs.

33 ADVANCED AUTOMOTIVE PROPULSION SYSTEMS

REFER ALSO TO CITATION(S) 42709

3301 Internal Combustion Engines

REFER ALSO TO CITATION(S) 43461

43454 **(DOE/AL/16310—T1) Lean engine efficiency: Final report, November 1980-January 1987.** Hoult, D.P.; Keck, J.C.; Ghoniem, A. (Massachusetts Inst. of Tech., Cambridge (USA). Dept. of Mechanical Engineering). Feb 1987. Contract AC04-81AL16310;AS04-78ET12301. 13p. NTIS, PC A03/MF A01; GPO Dep. Order Number DE88008517/JAW.

This report deals with studies of the combustion and flame propagation which occurs inside a spark ignition internal combustion engine. The research performed has had three main points of focus. The first focus was to develop a methodology for understanding of the turbulent processes which govern the rate of flame propagation in the engine. The second focus is the study of the knock process. The third focus is the numerical computation of solutions to the Navier Stokes equations using discrete vortex methods.

43455 **(DOE/NASA/0167—12) Advanced Gas Turbine (AGT) Technology Development Project: Final report.** (Allied-Signal Aerospace Co., Kansas City, MO (USA). Kansas City Div.). Mar 1988. Contract AI01-77CS51040. 385p. (NASA/CR—180891; GARRETT—31-3725(12)). NTIS, PC A17/MF A01;3; GPO Dep. Order Number DE88008534/JAW.

This report is the final in a series of Technical Summary Reports for the Advanced Gas Turbine (AGT) Technology Development Project, authorized under NASA Contract DEN3-167 and sponsored by the DOE. The project was administered by Mr. Thomas N. Strom, Project Manager, NASA-Lewis Research Center, Cleveland, Ohio. This report summarizes plans and progress from October 1979 through June 1987. Project effort conducted under this contract is part of the DOE Gas Turbine Highway Vehicle Systems Program. This program is directed at providing the United States automotive industry the high-risk, long range technology necessary to produce gas turbine engines for automobiles that will have reduced fuel consumption and reduced environmental impact. The intent is that this technology will be capable of reaching the marketplace by the 1990s. The Garrett/Ford automotive Advanced Gas Turbine has been designated the AGT101. The AGT101 nominally is a 74.5 kw (100 shp) engine, capable of speeds to 100,000 rpm and operating at turbine inlet temperatures to 1370C (2500F) with a specific fuel consumption level of 0.18 kg/kw-hr (0.3 lbs/hp-hr) over most of the operating range. This final report summarizes the powertrain design, power section development, and component/ceramic technology development. Appendices include summary reports of progress from Ford Motor Company, AiResearch Casting Company and Pure Carbon, acting as major subcontractors and suppliers of ceramic materials and components. Standard Oil Company's Unique and Common work accomplished under this program is published in topical report (TBD).

43456 **(DOE/NASA/0167—13) AGT 101: Ceramic component development: Advanced Gas Turbine Program: Topical report, October 1979-July 1987.** Ten Eyck, M.O.; MacBeth, J.W.; Sweeting, T.B. (Standard Oil Engineering Materials Co., Niagara Falls, NY (USA). Structural Ceramics Div.). Nov 1987. Contract AI01-77CS51040. 238p. NTIS, PC A11/MF A01; GPO Dep. Order Number DE88008535/JAW.

This topical report summarizes the ceramic component technology development activity conducted by Standard Oil Engineered Materials Company. Standard Oil, acting as a principal subcontractor and supplier of ceramic components, directed its efforts toward the development of ceramic materials in the silicon-carbide family. Various shape forming and fabrication methods, and non-de-

structive evaluation techniques were explored to produce the static structural components for the ceramic engine. This enabled engine testing to proceed without program slippage, and developed the approaches for producing low-cost, production quantity processes. Standard Oil contributed to the acceptance of ceramics as a viable approach for automotive gas turbine engines and to the advancement of this vital ceramic technology. 174 figs., 33 tabs.

43457 **Conclusions and recommendations: Toxicological effects of emissions from diesel engines.** McClellan, R.O. (Inhalation Toxicology Research Institute, Lovelace Biomedical and Environmental Research Institute, Albuquerque, NM (US)). pp 529-534 of Carcinogenic and mutagenic effects of diesel engine exhaust. Ishinishi, N.; Koizumi, A.; McClellan, R.O.; Stober, W. New York, NY; Elsevier Science Pub. Co. Inc. (1986). (CONF-8607363—).

From International satellite symposium on toxicological effects of emissions from diesel engines; Tsukuba Science City, Japan (26 Jul 1986).

This symposium and its proceedings include a great deal of information on the toxicological effects of diesel exhaust and specific chemical constituents. To summarize this material, the authors' returns to the risk assessment framework he offered in his opening remarkeds and considers information presented for hazard identification and exposure-dose-response assessments. As you will recall, he noted the need for using multiple approaches to obtaining the needed information. The author reviews each of the approaches as to the current status of our knowledge.

43458 **Analysis of genotoxic components in diesel engine emissions.** Hsieh, L.L.; Wong, D.; Heisig, V.; Santella, R.M.; Mauderly, J.L.; Mitchell, C.E.; Wolff, R.K.; Jeffrey, A.M. (Lovelace Inhalation Toxicology Research Institute, Albuquerque, NM (US)). pp 223-234 of Carcinogenic and mutagenic effects of diesel engine exhaust. Ishinishi, N.; Koizumi, A.; McClellan, R.O.; Stober, W. New York, NY; Elsevier Science Pub. Co. Inc. (1986). (CONF-8607363—).

From International satellite symposium on toxicological effects of emissions from diesel engines; Tsukuba Science City, Japan (26 Jul 1986).

The authors investigated the role of nitropyrenes and other genotoxic components in diesel engine emissions, in binding to cellular DNA and thereby presumably initiating the carcinogenic process. The techniques used included preparing monoclonal antibodies to specific nitropyrene-DNA adducts and the [/sup 32/P] post-labeling technique. Despite this concentration on the genotoxicity of diesel engine emissions, it must be remembered that chemical carcinogenesis is a multistep process and especially important in the case of exposures to complexmixtures. Thus the possibilities of co-carcinogenic or tumor promoting compounds being present in diesel engine emissions, although not specifically addressed in these studies, should not be ignored.

3307 Emission Control

REFER ALSO TO CITATION(S) 43971

43459 **(NP—8770261) Chemical adsorption and reaction of CO and NO on catalysts containing copper and nickel.** Hierl, R. (Muenchen Univ. (Germany, F.R.). Fakultaet fuer Chemie und Pharmazie). 26 Feb 1986. 355p. (In German). NTIS (US Sales Only), PC A16/MF A01. Order Number DE88770261/JAW.

In the context of this work, oxidized and reduced Spinel catalysts were examined for their behaviour relative to NO and CO. The method of investigation was thermal desorption spectroscopy, where helium was the carrier gas. During a typical experiment NO and CO were adsorbed in repeated adsorption/desorption cycles and were desorbed after an isothermal desorption phase by linear temperature rise in the carrier gas flow. The recording of these products occurred at every point in the experiment by a mass spectrometer and with a thermal conductivity detector. Numerical corrections carried out gave the possibility for the first time, of comparing and interpreting results of different experiments done at times widely apart. Based on the corrected, mass specific evolution, breakthrough and desorption profiles, conclusions were drawn on the properties of the adsorbed substances and information was obtained on the processes and chemical reactions on the sample surfaces. (orig./RB)

3308 Alternative Fuels

REFER ALSO TO CITATION(S) 42707, 43416

43460 **(CONF-880679—6) Cold weather methanol vehicle demonstration fleet at Argonne National Laboratory - implications for flexible fuel and dedicated methanol commercialization.** Saricks, C.L.; Larsen, R.P. (Argonne National Lab., IL (USA)). 1988. Contract W-31-109-ENG-38. 12p. NTIS, PC A 03; 3; GPO Dep. Order Number DE88011968/JAW.

From 81. annual meeting of Air Pollution Control Association; Dallas, TX, USA (1 Jun 1988).

As part of the US Dept. of Energy-sponsored fleet testing of methanol-fueled vehicles at various sites around the country, Argonne National Laboratory has been operating five M85 (85% methanol blend)-fueled Chevrolet S-10 pickups and five M85 Ford Crown Victorias on- and off-site since late 1986. Each fleet has a corresponding set of gasoline-fueled control vehicles. The objective of the Argonne testing program is to evaluate performance (including cold start-up), driver acceptance, durability and maintenance requirements of methanol-fueled engine systems operating in a cold climate. Results of the testing program will guide the Federal government in future use of methanol-powered fleets and vehicle manufacturers in making improvements and modifications to light-duty (spark-ignition) vehicle engine systems designed to operate on M85 or as flexible fuel (any mixture of gasoline and M85) vehicles. The paper presents some interim findings of this ongoing test program. Driveability, reliability and driver acceptance of the dedicated methanol vehicles has been found to be equivalent to their gasoline counterparts. Fuel economy (on an energy-equivalent basis) has overtaken that of the gasoline-powered units. Certification emissions for the vehicles met all Federal standards, and there is no indication to date of any accelerated degradation in emission system performance.

43461 **(MCR/IT—051985) Experimental development of an ammonia fueled engine. Final report.** Shand, R.; Thomas, W.; Reese, G.; Kristiansen, C. (Manitoba Research Council, Winnipeg (Canada). Industrial Technology Centre). 10 May 1985. 171p. (CE—01578). CANMET/TID, Energy, Mines and Resources Canada, 555 Booth St., Ottawa, Ont., Canada K1A 0G1; $0.34CAN per page, $3.40 CAN minimum.

An 8.2 liter Detroit Diesel engine was modified for single cylinder Otto cycle operation and tested at various compression ratios using ammonia fuel. At 1,800 rpm, a best net indicated thermal efficiency of 47.5% was achieved with an 18:1 compression ratio. This performance was achieved using a vapor carburator, high energy ignition system, and high combustion chamber turbulence to promote rapid combustion. No secondary fuel addition or combustion enhancers in the fuel were required over the tested speed range of 1,000 to 3,000 rpm for smooth and efficient engine operation. This engine, which was naturally aspirated, achieved a power output with ammonia fuel equal to that achieved with a turbocharged engine using diesel fuel. Tests conducted using hydrogen addition did not provide increased power output, however, a slightly higher thermal efficiency of 49.5% was achieved. Engine performance data for each compression ratio and exhaust emissions and pressure volume data for the 18:1 compression ratio are presented. Catalytic treatment of the exhaust gases reduced the unburned ammonia emissions to less than 50 ppm, but increased the nitric oxide emissions under some conditions. The air/fuel ratio had a large effect on nitric oxide emissions. Includes computer program to calculate volume and temperature conversion profiles of an ammonia dissociator. 40 refs., 56 figs., 77 tabs.

43462 **(MIRA-Trans—31/87) Development and testing of alcohol fuels for commercial vehicle diesel engines.** Heinrich, W. Translated from *Motortechnische Zeitschrift ;* vp(Mar 1987). 28p. British Library Document Supply Centre, Boston Spa, Wetherby, West Yorks. LS23 7BQ.

A report is given of trials of the suitability of methanol and ethanol for use in commercial vehicle engines. As such, the engine is based on the diesel principle and the main task was to develop and test suitable ignition improvers to overcome the relatively poorer quality of the lower alcohols. It was found that many such improvers are available but the uptake of such alcohol fuels depends on local economic and political conditions as well as the international price of oil.

35 ARMS CONTROL

43463 (IC/PD—8) Nuclear security, disarmament and development: Physics and development, No. 8. Salam, A. (International Atomic Energy Agency, Vienna (Austria); International Centre for Theoretical Physics, Trieste (Italy)). Jun 1987. 149p. NTIS, PC A05/MF A01;1; GPO Dep. Order Number DE88900646/JAW.

The ICTP Physics and Development Programme resulted from the recognition that the scientific, economic and social progress of the developing nations is strongly interrelated and from the recognition that physical and mathematical sciences play an exceedingly important role in providing satisfactory solutions to problems of development in general. Renowned experts are usually invited to give lectures on science and technology, economics and planning, with particular reference to the needs of developing countries. The purpose is to improve the awareness of scientists visiting the Centre, of the current technical, economic and social aspects of development, thereby assisting them in better utilizing their talent in the development programmes of their counties. The following topics are discussed: Nuclear security, disarmament and development; military technology, war and peace in the contemporary world; the role of education; renewable energy resources and developing countries; future prospects for mathematics in Africa. 90 refs., 4 figs., 14 tabs.

3501 Policy, Negotiations, And Legislation

REFER ALSO TO CITATION(S) 43285

43464 (LA—11234-MS) The INF Treaty: Past, present, and future. Garrity, P.J. (Los Alamos National Lab., NM (USA). Center for National Security Studies). Feb 1988. Contract W-7405-ENG-36. 13p. (CNSS/Papers—4). NTIS, PC A03/MF A01; GPO Dep. Order Number DE88008438/JAW.

This informal paper is intended to provide information to the Los Alamos National Laboratory staff about the recently-signed INF Treaty (formally, the "Treaty between the United States of America and the Union of Soviet Socialist Republics on the Elimination of Their Intermediate-Range and Shorter-Range Missiles"). It consists of (a) historical background concerning the US/NATO objectives in deploying and negotiating over INF systems; (b) a synopsis of the treaty's provisions with a brief commentary; (c) discussion of the possible impact of the treaty on future American and alliance security policy; and (d) an appendix which contains a summary chronology of events relative to INF from 1979 to 1987.

3502 Proliferation

REFER ALSO TO CITATION(S) 43285

3503 Verification

REFER ALSO TO CITATION(S) 43464, 43822

36 MATERIALS

3601 Metals And Alloys

REFER ALSO TO CITATION(S) 42835, 42974, 43049, 43078, 43096, 43097, 43098, 43165, 43314, 43370, 43429, 43672, 44312

43465 (AD-A—192093/3/XAB) Effect of alloying, rapid solidification, and surface kinetics on the high-temperature environmental resistance of niobium. Technical report, January 1987-January 1988. Perkins, R.A.; Meier, G.H.; Miller, R.A.; Chiang, K.T. (Lockheed Missiles and Space Co., Inc., Palo Alto, CA (USA). Research and Development Div.). 8 Jan 1988. 49p. (LMSC/F—24660). NTIS, PC A03/MF A01.

An improved understanding of factors governing the selective oxidation of aluminum to form continuous alumina scales on modified niobium-aluminum alloys was established. It was demonstrated that highly protective alumina scales can be formed on niobium-titanium-chromium-vanadium-aluminum alloys without transient oxidation products at temperatures of 1400 to 1600 C in air. Aluminum content was identified as the critical factor controlling single layer alumina formation. It was also shown that the N/sub Al/(crit) for the formation of a continuous alumina scale is 0.375 to 0.38 at 1400 C, decreasing slightly with increased Nb-Ti ratio in the alloy. A fourth element must be added to niobium-titanium-aluminum for effective alumina formation. It has been established that this element should be from a group that can reduce the solubility-diffusivity at 1400 - 1600 C. Alumina can be formed at 1400 C by substituting V or Ti but a liquid transient oxide is produced. A high rate of transient oxidation relative to alumina formation in this range accelerated transient oxidation and precluded alumina growth instead.

43466 (CEA-CONF—9284) Influence of alloying elements on the dislocation loops created by Zr/sup +/ ion irradiation in alpha-zirconium. Hellio, C.; Novion, C.H. de. (Institut National des Sciences et Techniques Nucleaires (INSTN), Centre d'Etudes Nucleaires de Saclay, 91 - Gif-sur-Yvette (France); CEA Centre d'Etudes Nucleaires de Saclay, 91 - Gif-sur-Yvette (France). Service de Recherches Metallurgiques Appliquees). 1987. 22p. (CONF-8706324—). NTIS (US Sales Only), PC A03/MF A01. Order Number DE88754043/JAW.

From International workshop on mechanisms of irradiation creep and growth; Hecla Island, Canada (22 Jun 1987).

Pure zirconium and four (annealed) α - zirconium based alloys (Zr-1760 ppm weight 0, Zr - 1% Nb - 430 ppm 0, Zr-1% Nb-1800 ppm 0, zircaloy 4) have been studied by transmission electron microscopy after 500 keV Zr/sup +/ ion or 1 MeV electron irradiation performed at high temperature. Type of burgers vectors of the dislocation loops are given; in the case of electron irradiated Zr-1760 ppm 0, the larger loops were found of interstitial type. Alloying elements increase the loop density. The kinetic of loop growth was observed in-situ during 1 MeV electron irradiation between 400 and 700/sup 0/C: oxygen was found to reduce considerably the growth speed of loops. In-situ annealing at 450 or 500/sup 0/C after ion irradiation led to a large coalescence of loops in the case of pure zirconium, but modified only slightly the defect structure of the alloys.

43467 (CEA-CONF—9294) Kondo effect and heavy fermions in Yb compounds. Bonville, P. (CEA Centre d'Etudes Nucleaires de Saclay, 91 - Gif-sur-Yvette (France). Service de Physique du Solide et de Resonance Magnetique). 1987. 15p. (CONF-870825—). NTIS (US Sales Only), PC A03/MF A01. Order Number DE88754044/JAW.

From International conference on the applications of the Mossbauer effect; Melbourne, Australia (17 Aug 1987).

The Kondo properties of Yb dilute alloys and intermetallics have been investigated using Moessbauer spectroscopy on /sup 170/Yb. In the dilute alloys AuYb and LaBe/sub 13/Yb, the Kondo logarithmic anomaly of the impurity relaxation rate has been detected, and in the concentrated Yb compounds YbBe/sub 13/, YbP and YbAs, and YbCuAl, the manifestations of the interplay between the Kondo effect and the magnetic ordering due to the RKKY interaction have been characterized.

43468 **(CNEA-NT—16/86) Phenomena of the ionic transport in the stress corrosion of metals.** Gravano, S.M. (Comision Nacional de Energia Atomica, Buenos Aires (Argentina). Gerencia de Desarrollo; Universidad Nacional de Cuyo, Mendoza (Argentina). Inst. Balseiro). Jul 1986. 408p. (In Spanish). (CNEA-PMTM/T—6). NTIS (US Sales Only), PC A18/MF A01. Order Number DE88702502/JAW.

For the study of electrochemical conditions of propagation, a model which calculates the concentrations and potential profiles inside cracks or localized corrosion cavities, was developed. Considering transport by difussion and migration it was applied to pure metals (Zn, Fe) in solutions where pitting occurs (NaCl or Na2SO4, with borate buffer), and also extended to systems where stress corrosion cracking is present, such as Cu and yellow brass in NaNO2. Physical bases of the 'constant intermediate elongation rate technique' to predict stress corrosion cracking susceptibility was analized, studying by mathematical models: 1) dissolution current, that should be the result of superposition of repassivation transients on the fresh metal, exposed to corrosive medium by strain, with the same rate of that of a static specimen; 2) ohmic drop, that in some systems could be quite important and it must be considered in the overpotential evaluation; and 3) metallic ion concentration that, instead of what happens in a crack, never attains saturation in the analized cases. For repassivation transient according to the crack propagation models proposed by Scully and Ford it was found that, at the tip of the crack, it is unlikely that the same repassivation transients occur as in the constant intermediate elongation rate experiments. (M.E.L.).

43469 **(CONF-880549—2) Effect of double layer structure on the determination of corrosion rates from polarization measurements.** Nagy, Z.; Schultz, P.F. (Argonne National Lab., IL (USA)). 1988. Contract W-31109-ENG-38. 9p. NTIS, PC A03/MF A01;1; GPO Dep. Order Number DE88010097/JAW.

From Electrochemical Society spring meeting; Atlanta, GA, USA (15 May 1988).

The effect of the double layer structure is very seldom considered in the electrochemical measurements of corrosion rates. Polarization equations of corroding metals can be corrected for the effect of the double layer using the classical Frumkin correction of electrode kinetics. This corrected polarization equation can be used to generate synthetic data which, in turn, permit the calculation of the error caused by the neglect of the double layer effect in the electrochemical corrosion rate determinations. While the error depends on many parameters, the two dominating factors are the concentration of the solution and the potential of the corroding metal with respect to the potential of zero change (pzc). The error will be negligible (less than ten percent) if the solution concentration is at least 0.1 molar or the corrosion potential is at least {+-}0.25 V from the pzc. The error can be very large, many hundreds or thousands of percents, unless at least one of the above conditions is met, and the appearance of the polarization curves will have no clear indication of the unreliability of the measurement. Under these conditions, the electrochemical measurements should be supplemented with other types of corrosion rate determinations, or a correction can be made if the double layer parameters are known. 5 refs., 4 figs.

43470 **(EFI-TR—3408) Corrosion in marine atmosphere.** Refsnaes, S.; Anda, O. (Elektrisitetsforsyningens Forskningsinstitutt, Trondheim (Norway)). Jun 1987. 60p. (In Norwegian). NTIS (US Sales Only), PC A04. Order Number DE88752093/JAW.

The report deals with the corrosive effect from marine atmosphere and precipitation in the Norwegian coastal areas. On the basis of corrosion damages for power transmission lines, various quick recording measuring methods for the classification of corrosive effects in atmosphere are investigated. The measuring method for steel is presented. 26 drawings, 18 tables.

43471 **(EPRI-NP—5863) High-temperature electrochemistry and corrosion: Final report.** Bogaerts, W.F.; Bettendorf, C. (Electric Power Research Inst., Palo Alto, CA (USA); Leuven Univ. (Belgium). ECHEM Labs.). May 1988. 110p. Research Reports Center, Box 50490, Palo Alto, CA 94303. Order Number TI88011695/JAW.

This report deals with problems and techniques of high-temperature electrochemical corrosion measurements. It describes a high- performance external reference electrode system and analyses thermal liquid junctions in such a system. A generally valid expression to calculate corrections for the potential readings of this type of reference electrode is derived. Extensive data are reported with respect to surface-chemical reactions of Fe--Cr--Ni alloys in various high temperature aqueous environments. The main emphasis is on depassivation processes and chloride reactions at the metal surface. Based on these results, different aspects of the high temperature pitting phenomenon are explained. Results are also presented about the inhibition of stress corrosion cracking in high temperature water by means of phosphate and molybdate. 99 refs., 46 figs., 20 tabs.

43472 **(FEI—1862) Energetic aspects of spontaneous reconstruction of chromium domain structure.** Levdik, V.A.; Bykov, V.N. (Gosudarstvennyj Komitet po Ispol'zovaniyu Atomnoj Ehnergii SSSR, Obninsk. Fiziko-Ehnergeticheskij Inst.). 1987. 16p. (In Russian). NTIS (US Sales Only), PC A03/MF A01. Order Number DE88703497/JAW.

Analysis of antiferromagnetic chromium crystal lattice elastic strain energy is conducted and expressions for strain tensor depending on crystal structure configuration and character are derived. Experimentally ascertained regularities of domain structure spontaneous reconstruction, observed in chromium crystals, are mathematically grounded using temperature dependence of elastic and magnetocrystalline anisotropy energy. 6 refs.; 2 figs.

43473 (INIS-mf—11044, pp 102-120) **Characterization of a NIMONIC TYPE super alloy.** Zamora Rangel, L.; Martinez Martinez, E. (Instituto Nacional de Investigaciones Nucleares, Mexico City). 1985. (In Spanish). NTIS (US Sales Only), PC A07/MF A01. Order Number DE88780072/JAW. (CONF-8508261—).

From Seminar of the Division of Materials and Testing; Salazar, Mexico (23 Aug 1985).

Mechanical properties of strength and thermofluence of a NIMONIC type super alloy under thermal treatment was determined. The relationship between microstructure, phases and precipitates was also studied.

43474 **(JAERI-M—88-003) Creep behavior for Hastelloy-XR.** Muto, Yasushi; Hada, Kazuhiko; Ogawa, Yutaka; Ikeda, Sadao. (Japan Atomic Energy Research Inst., Tokyo). Feb 1988. 54p. (In Japanese). NTIS (US Sales Only), PC A04/MF A01. Order Number DE88753428/JAW.

Creep-rupture tests for Hastelloy-XR, a Ni-base heat resistent alloy, were conducted in air at the temperature of 650 to 900 deg C. Times to rupture ranged from 1000 to 16000 h. As results of tests, creep curves were observed to vary depending on both temperature and stress, particularly on temperature. Namely, they showed typical classical shapes consisting of primary, secondary and tertiary creep at 650 to 700 deg C. The regions of primary and secondary creep decreased gradually as the temperature became higher and in one case of 900 deg C and high stress, only tertiary creep was observed. Metallurgical observation by optical microscope showed the similar inclination. Some differences were found concerning rupture morphology and void shape between temperatures below 750 deg C and above 850 deg C.

43475 (KFTI—87-34) Model of metallic glass. Akhiezer, I.A.; Davydov, L.N. (AN Ukrainskoj SSR, Kharkov. Fiziko-Tekhnicheskij Inst.). 1987. 8p. (In Russian). NTIS (US Sales Only), PC A02/MF A01. Order Number DE88703788/JAW.

A simple two-level model hamiltonian (Nakano-Ising hamiltonian) is used to analyze phase transitions among three types of condensed state of simple (monatomic) substances: liquid, crystalline and glassy. A phase diagram of condensed state in (T, κ) plane where T is temperature and κ is the level of frozen fluctuations is plotted. 11 refs.; 1 fig.

43476 (KFTI—87-36) Self-consistent model for metal-metalloid glasses. Akhiezer, I.A.; Davydov, L.N.; Spol'nik, Z.A. (AN Ukrainskoj SSR, Kharkov. Fiziko-Tekhnicheskij Inst.). 1987. 6p. (In Russian). NTIS (US Sales Only), PC A02/MF A01. Order Number DE88703789/JAW.

A model of glasses of the metal-metalloid type is suggested.Its thermodynamics of Bernal-Polk complexes is plotted on the basis of Ising-Nakano hamiltonian and the theory of frozen fluctuations. The upper temperature boundary of glassy state existence(crystallization temperature) is determined. General ratios for diffusion coefficient with cooperative diffusion mechanism are obtained. The temperature coefficient dependence in cases of high and low dispersion coupled interatomic correlations is studied. 16 refs.; 1 fig.

43477 (NUCLEBRAS-CDTN—517) Aspects of plasma arc cutting process in the AISI 321 type stainless steel. Souza Barros, I. de. (Centro de Desenvolvimento da Tecnologia Nuclear, Belo Horizonte (Brazil)). 1985. 94p. (In Portuguese). NTIS (US Sales Only), PC A05/MF A01. Order Number DE88702611/JAW.

Some aspects of plasma arc cutting process in the AISI321 stainless steel, used in nuclear industry, are analysed. The maximum values of the velocity of cutting and, the minimum quantity of energy per unit of length necesary for the plasma were determined. The localization of irregularities in the cut surface in function of the velocity of cutting was investigated. The cut surfaces were evaluated by surface roughness, using as measurement parameter, the distance between the sharpest salience and the deepest reentrance of the sample profile. The width of layer from thermal action of the plasma was influenced by the velocity of cutting.

43478 (PB—88-203070/XAB) Hot isostatic pressing of tungsten-nickel-iron composites. Ekbom, L.; Eliasson, A.; Bogegard, S. (Foersvarets Forskningsanstalt, Stockholm (Sweden)). Feb 1988. 18p. (In Swedish). (FOA-C—20698-2.1). NTIS, PC E03/MF A01.

Heavy metals or tungsten-nickel-iron alloys are usually produced from powders by liquid-phase sintering. During this process a nickel-iron-tungsten melt is formed in which tungsten crystals are growing to a spherical shape. The resulting particle composite structure gives the material good mechanical properties. Studies were made to learn to what extent the liquid phase sintering could be replaced by HIP. For this purpose, blends of different W, Ni and Fe powders were filled into steel containers, reduced by hydrogen around 800°C, evacuated, and sealed. This investigation shows that the microstructure after HIP is dependent of the powder grain size. To be able to improve the microstructure after HIP, the grain size of nickel and iron powders must be about one tenth of that of the tungsten powder.

43479 (RFP—4156) Grain growth and the recrystallized grain size for the uranium-7.4 weight percent niobium alloy. Jackson, R.J.; Thomas, R.L. (ed.). (Rockwell International Corp., Golden, CO (USA). Rocky Flats Plant). 17 Jun 1988. Contract AC04-76DP03533. 14p. NTIS, PC A03/MF A01; 1; GPO Dep. Order Number DE88013616/JAW.

The recrystallized gamma grain size and grain-growth kinetics were determined for the uranium-7.4 wt% niobium alloy (17.0 at.%). It was found that metal deformation is necessary for grain refinement in this alloy. The alloy was studied under three conditions: (1) the percent cold reduction and annealing temperature were held constant while the time at temperature was varied; (2) the percent cold reduction and annealing time were held constant while the annealing temperature was varied; and (3) the percent cold reduction was varied while the annealing time and temperature were held constant. The recrystallized gamma gain size was equal to or less than eight microns for the moderately worked U-7.4 wt% Nb alloy. The grain-growth exponent was 0.33 at 700{degree}C. The activation energy for grain growth was 7 kcal per mole. 17 refs., 8 figs., 1 tab.

43480 (UCRL—52000-88-4) Energy and Technology Review, April 1988. (Lawrence Livermore National Lab., CA (USA)). Apr 1988. Contract W-7405-ENG-48. 31p. NTIS, PC A03/MF A01;1; GPO Dep. Order Number DE88012170/JAW.

Energy and Technology review is published monthly to report on unclassified work in all Lawrence Livermore National Laboratory Programs. This issue contains reports on the following topics: "Composite Materials--Characterizing their Mechanical Properties", "Development of an Aluminum-Air Battery for an Electric Vehicle", and "Recombinant DNA Biotechnology and the Bioconversion of Metals". (LDL)

43481 Mass transport during laser chemical vapor deposition. Copley, S.M. (Departments of Materials Science and Mechanical Engineering, Center for Laser Studies, University of Southern California, Los Angeles, California 90089-0241). *Journal of Applied Physics;* **64**: No. 4, 2064-2068(15 Aug 1988).

Two analyses of steady-state mass transport during laser chemical vapor deposition (LCVD) are compared for a hemispherical source/sink geometry. The first considers only diffusion while the second includes diffusion and also convection due to the mole number change of vapor species in the reaction, which is modeled as the radial outflow of an incompressible gas from a point source. The results of the two analyses differ markedly for high deposition fluxes and large radii. For example, in the LCVD of Ni from $Ni(CO_4)$, reactant partial pressures at the hemispherical surface predicted by the diffusion plus convection analysis are less than those predicted by the diffusion analysis because the inward diffusion of the reactant species is hindered by the convective outflow of the product species. The diffusion analysis predicts an increase in total pressure at the hemispherical surface, which normally is relieved by the neglected convective flow. Bounds for transport controlled deposition and for deposition where convection can be safely neglected are specified. The diffusion plus convection analysis is generalized to cover a surface distribution of sources/sinks, and can be employed to predict local partial pressures in steady-state LCVD.

43482 Radiation-enhanced diffusion in Ni/Zr diffusion couples. Ding, F.; Averback, R.S.; Hahn, H. (Materials Science Division, Argonne National Laboratory, Argonne, Illinois 60439). *Journal of Applied Physics;* **64**: No. 4, 1785-1790(15 Aug 1988).

Radiation-enhanced diffusion and ion-beam mixing in Ni/Zr diffusion couples were investigated. The Kirkendall geometry was employed for this experiment to determine the radiation-enhanced diffusivities of both Ni and Zr in the amorphous (a-) NiZr interdiffusion zone. W, Au, and Hf were employed as markers. The activation enthalpy for radiation-enhanced interdiffusion was determined to be $\approx$0.4 eV, and Ni was found to be the faster moving species. The dose-rate dependence of the interdiffusion coefficient in the a-NiZr was typical of that of crystalline materials and suggests a point-defect-like diffusion mechanism in irradiated metallic glasses.

43483 Dynamic consolidation of type 304 stainless-steel powders in gas gun experiments. Flinn, J.E.; Williamson, R.L.; Berry, R.A.; Wright, R.N.; Gupta, Y.M.; Williams, M. (Idaho National Engineering Laboratory, EG&G Idaho, Inc., P. O. Box 1625, Idaho Falls, Idaho 83415). *Journal of Applied Physics;* **64**: No. 3, 1446-1456(1 Aug 1988).

Specimens of type 304 stainless-steel powder consolidated using projectile impacts from a 10.2-cm gas gun have been recovered intact and the microstructures have been characterized. Variables for the study included two types of 304 stainless-steel powder, cavity depth, and peak stresses ranging from 11.7 to 21.1 GPa. All specimens exhibited three-dimensional contractions with approxi-

mately one-half of the densification associated with thickness. Some porosity from entrapped gas as a result of not evacuating the powder-filled cavities and microcracks due to the recovery method were observed. In the regions free of these defects, full densification was observed. The 11.7-GPa experiment produced considerable work hardening. The bonding around the particle perimeters ranged from melted regions to mechanical abutment. The 21.1-GPa experiment resulted in lower hardness, reduced metastable bcc phase, and more extensive bonding around the particle perimeters. These observations suggest that very high localized, and relatively high bulk temperatures were achieved for this peak stress. A two-dimensional numerical simulation, with the powder region considered as a two-component mixture, was used to examine the overall response of the powder-filled cavities and surrounding target to the stress wave. The calculations predicted the observed density change and the observed final shape for the compacted powder. Two-dimensional numerical simulations, in which the particles were individually modeled, were also performed to assess the behavior at the particle level. The deformation of the particles necessary to fill the interstitial regions along with the corresponding temperatures around the perimeters of the particles and their interiors were calculated.

43484 **Imaging of 5f densities of states in resonant photoemission measurements.** Arko, A.J.; Koelling, D.D.; Capasso, C.; del Giudice, M.; Olson, C.G. (Los Alamos National Laboratory, Los Alamos, New Mexico 87545). *Physical Review* [*Section*] *B: Condensed Matter;* **38**: No. 3, 1627-1631(15 Jul 1988).

Medium-resolution spectra ($\Delta E = 0.25$ eV) at the 5f Fano resonance in uranium intermetallics are compared to spectra above and below the resonance region to show that the 5f (and 6d) spectral weight obtained from resonant photoemission (RP) compares well to the 5f spectral weight obtained at other photon energies. In well-hybridized systems, the 5f signal from RP gives an excellent representation of the 5f density of states (DOS). In narrow-band and localized systems, a satellite may appear in addition to 5f DOS-like structure, indicative of correlation effects.

43485 **Local-orbital basis for defect electronic structure calculations of an Al(100) film.** Feibelman, P.J. (Sandia National Laboratories, Albuquerque, New Mexico 87185). *Physical Review* [*Section*] *B: Condensed Matter;* **38**: No. 3, 1849-1855(15 Jul 1988).

Preliminary to performing first-principles scattering-theory calculations of adsorbate and defect properties on Al(100), a linear combination of atomic orbitals (LCAO) basis of 53 rather short-ranged contractions of Gaussians has been constructed which reproduces the electronic level structure of a well-converged linearized augmented-plane-wave (LAPW) calculation for a five-layer Al(100) film to better than 0.15 eV. Using this basis, a scattering-theory evaluation of the force on a single surface Al atom of an ideal film shows it to be inward and equal to about 0.02 eV/bohr. A search for the outer Al layer height at which this force vanishes implies a slight reduction of the outer-layer separation, about 0.25%. This result also agrees with the LAPW result. Neither spectroscopic nor geometric LCAO results agree well with those of the LAPW if d-like Al-centered orbitals are not included in the LCAO basis.

43486 **Energetics and lattice relaxation of light impurities in aluminum.** Perrot, F.; Rasolt, M. (Commissariat a l'Energie Atomique, Boite Postale 27, F-94190 Villeneuve-Saint-Georges, France). *Physical Review* [*Section*] *B: Condensed Matter;* **38**: No. 3, 2147-2150(15 Jul 1988).

We present results of calculations for a series of impurities He, Li, Be, B, C, N, O, F, and Ne in an Al lattice, using the spherical-solid model. The relaxation displacements of the ions around the impurities at the octahedral site (i) vary rather smoothly with the impurity atomic number and (ii) show some structure. These results cannot be correlated with the size of the impurity in its atomic state, but involve the details of the density displaced in the host.

43487 **Depth dependence for extended x-ray-absorption fine-structure spectroscopy detected via electron yield in He and in vacuum.** Elam, W.T.; Kirkland, J.P.; Neiser, R.A.; Wolf, P.D. (Condensed Matter Physics Branch, Condensed Matter and Radiation Science Division, Naval Research Laboratory, Washington, D.C. 20375-5000). *Physical Review* [*Section*] *B: Condensed Matter;* **38**: No. 1, 26-30(1 Jul 1988).

X-ray absorption spectra have been measured using electron detection with both vacuum and helium gas surrounding the samples. The samples consisted of thin iron films covered with various thicknesses of aluminum to determine the contribution versus depth. The height of the iron K—absorption-edge jump decreases exponentially with aluminum covering thickness, with a 1/e depth of 1600 A. The addition of helium gas forms an ionization detector for the electrons, which have an average energy of about 2500 eV. The effects of electrode geometry and bias voltage are evaluated. When operated in a linear-response region, the signal-to-noise ratio for this method is excellent and the extended x-ray-absorption fine-structure (EXAFS) amplitudes agree with transmission measurements to better than 3%.

43488 **Observation of itinerant-electron effects on the magnetic excitations of iron.** Paul, D.M.; Mitchell, P.W.; Mook, H.A.; Steigenberger, U. (Department of Physics, University of Warwick, Coventry CV47AL, United Kingdom). *Physical Review* [*Section*] *B: Condensed Matter;* **38**: No. 1, 580-582(1 Jul 1988).

Triple-axis neutron spectroscopy has been used to study high-energy magnetic excitations for iron. The scattering contours established for the [100] and [111] directions show effects not present in localized-electron models of ferromagnetism. Interactions between spin waves and single-particle excitations are clearly seen for both crystallographic directions while two parts to the spin-wave branch are observed for the [100] direction.

43489 **Horizontal electromagnetic casting of thin metal sheets.** Hull, J.R.; Lari, R.J.; Praeg, W.F.; Turner, L.R. (to Dept. of Energy, Washington, DC). US Patent 4,741,383. 3 May 1988. Filed date 23 Mar 1987. vp. Patent and Trademark Office, Box 9, Washington, DC 20232.

A method for the horizontal casting of a thin metal sheet is described comprising; providing a supply of molten metal; forming the molten metal into a thin, horizontal sheet in motion along its length; directing an alternating magnetic field across the width of and about the molten metal sheet; positioning a conductive shield within the magnetic field and electrically coupling the conductive shield to the molten metal sheet for at least partially shielding the molten metal sheet from the magnetic field to define a horizontally oriented equilibrium position within the magnetic field, wherein the strength of the magnetic field increases with increasing displacement of the molten metal sheet below the equilibrium position and decreases with increasing displacement of the molten metal sheet above the equilibrium position such that the magnetic field exerts a constant uniform levitating force on the molten metal sheet in the equilibrium position.

43490 **Effect of grain boundary migration on apparent boundary diffusion coefficients.** Glaeser, A.M.; Evans, J.W. (Dept. of Materials Science and Mineral Engineering, and Materials and Molecular Research Div., Lawrence Berkeley Lab., Univ. of California, Berkeley, CA (US)). *Acta Metallurgica;* **34**: No. 8, 1545-1552(Aug 1986).

The effect of grain boundary migration on the tracer concentration depth profiles that develop during a diffusion experiment is evaluated. An expression for the average tracer concentration within a plane at depth x and time t for a boundary migrating with velocity V is derived. this average concentration is compared to that expected for a stationary boundary. Results indicate that errors in the magnitude and temperature dependence of the apparent diffusion coefficient may arise if grain boundary migration is neglected.

3602 Ceramics, Cermets, And Refractories

REFER ALSO TO CITATION(S) 43075, 43314, 43314, 43456, 43629, 44308, 44470

43491 (CONF-880206—14) Oxygen desorption from high and low T/sub c/ superconductors. Locquet, J.P.; Strauven, H.; Wuyts, B.; Verberke, O.B.; Zhang, K.; Schuller, I.K.; Vanacken, J.; Van Haesendonck, C.; Bruynseraede, Y. (Argonne National Lab., IL (USA); California Univ., San Diego, La Jolla (USA). Dept. of Physics; Louvain Univ. (Belgium). Dept. of Physics). Mar 1988. Contract W-31-109-ENG-38. 3p. NTIS, PC A 02; 3; GPO Dep. Order Number DE88011980/JAW.

From International conference on high temperature superconductors and materials and mechanisms of superconductivity; Interlaken, Switzerland (29 Feb 1988).

High temperature oxygen evolution data are used to calculate the thermodynamic parameters related to the oxygen bonding and oxygen-oxygen repulsion energy in various superconducting compounds. The observed oxygen desorption from the linear Cu-O chains in the high T/sub c/ superconductors ($YBa_2Cu_3O_7$, $LaBa_2Cu_3O_7$, Pr/sub x/Y/sub 1-x/$Ba_2Cu_3O_7$) is not present in the low T/sub c/ superconductors (La_2CuO_4, La/sub 2-x/Sr/sub x/CuO_4). Above 800°C all samples show sharp oxygen evolution peaks.

43492 (CONF-880403—2) Ceramic fabrication processes for high-T/sub c/ superconductors. Poeppel, R.B.; Goretta, K.C.; Lanagan, M.T.; Dusek, J.T.; Degener, J.K. (Argonne National Lab., IL (USA)). Mar 1988. Contract W-31-109-ENG-38. 5p. NTIS, PC A 02; 3; GPO Dep. Order Number DE88011991/JAW.

From American power conference; Chicago, IL, USA (25 Apr 1988).

Several ceramics are known to be superconductors above the temperature of liquid nitrogen. Conventional ceramic processing techniques can be used to fabricate each of these ceramics into useful conductors. A common and versatile means of forming monofilament conductors is to mix superconductor powder with plastics, and then form the plastic mass into the desired shape. Postforming heat treatment burns off the plastics and yields dense final products. The constituents of the plastic mix, and the forming and firing processes used to fabricate YBa_2Cu_3O/sub 7-x/ superconductors shall be discussed.

43493 (CONF-880408—31) Kinetic processes of the orthorhombic to tetragonal phase transition in YBa_2Cu_3O/sub 7-δ/. Shi, D.; Capone, D.W. II. (Argonne National Lab., IL (USA)). Feb 1988. Contract W-31-109-ENG-38. 5p. NTIS, PC A 02; 3; GPO Dep. Order Number DE88011993/JAW.

From Spring meeting of the Materials Research Society; Reno, NV, USA (4 Apr 1988).

The kinetic processes driving the orthorhombic to tetragonal (O-T) phase transition in YBa*Cu#O/sub 7-δ/ have been explored to study the formation of the 123 superconducting phases at different temperatures, as well as the oxygen diffusion in the 123 material. An isothermal transformation curve marking the O-T phase transition boundaries has been established over a wide temperature range. These data suggest the existence of two thermodynamically distinct superconducting phases in the 123 material. Magnetization vs. field data are presented for the samples that were isothermally annealed at 400°C. The results indicate that the T-O transformation is a nucleation and growth process which is governed by oxygen diffusion. The growth geometry during the T-O transformation is discussed.

43494 (CONF-880504—4) Texturing of RBa_2Cu_3O/sub 7-x/ superconductors. Goretta, K.C.; Schultz, A.J.; Capone, D.W. II; Tolt, T.L.; Balachandran, U.; Dusek, J.T.; Lanagan, M.T.; Poeppel, R.B.; Singh, J.P.; Shi, D. (Argonne National Lab., IL (USA)). Apr 1988. Contract W-31-109-ENG-38. 10p. NTIS, PC A02/MF A01; 1; GPO Dep. Order Number DE88011987/JAW.

From 90. annual meeting of American Ceramic Society; Cincinnati, OH, USA (1 May 1988).

Ceramic superconductors have been textured mechanically in the green state during plastic extrusion and tape and slip casting. The resultant weak-to-moderate textures have been identified by x-ray and neutron diffraction as preferential alignment of c axes normal to the conductor surface. Texturing gave rise to significant increases in critical current density (J/sub c/), although low specimen densities or presence of second phases limited the improvements in J/sub c/.

43495 (INIS-BR—1008) U/sub 3/O/sub 8/ microspheres sintering kinetics. Godoy, A.L.E. (Instituto de Pesquisas Energeticas e Nucleares, Sao Paulo (Brazil)). 1986. 109p. (In Portuguese). NTIS (US Sales Only), PC A06/MF A01. Order Number DE88702592/JAW.

U/sub 3/O/sub 8/ microspheres sintering kinetics was determined using a hot-stage optical microscopy apparatus, able to reach temperature up to 1350/sub 0/C in controlled atmospheres. The sintered material had its microstructure analysed by optical and electron microscopy. The microspheres were characterized initialy utilizing X-ray diffractometry and thermogravimetry. The equation which describes the microspheres shrinkage in function of the time was obtained using finite difference analysis X-ray diffractometry indicated hexagonal structure for the microspheres main starting material, ammonium diuranate thermogravimetric analysis showed reduction of this material to U/sub 3/O/sub 8/ at 600/sub 0/C. Ceramography results showed 5 hours sintered microspheres grain sizes G vary with the temperature. Sintered U/sub 3/O/sub 8/ micrographs compared with published results for UO/sub 2/, indicate similar homogeneity microstructural characteristics and suggest the processed micorspheres to be potentially useful as nuclear fuels.

43496 (INIS-mf—11210, pp V42-V44) **Example for the potential applications of americium-242m as a nuclear fuel.** Ronen, Y.; Leibson, M.J. (Ben-Gurion Univ. of the Negev, Beersheba (Israel). Dept. of Nuclear Engineering). Dec 1987. NTIS (US Sales Only), PC A13/MF A01. Order Number DE88780087/JAW. (CONF-871287—).

From Nuclear Societies of Israel annual meeting; Haifa, Israel (21 Dec 1987).

Transactions.; V. 14.

43497 (JAERI-M—87-217) Data compilation for radiation damage on ceramic insulators. Revised with updated data and reviews. Fukuya, Koji; Terasawa, Mititaka; Ozawa, Kunio. (Japan Atomic Energy Research Inst., Tokyo). Jan 1988. 181p. NTIS (US Sales Only), PC A09/MF A01. Order Number DE88753426/JAW.

Data of radiation effects on ceramic insulators were compiled from the literatures and summarized from the viewpoint of fast neutron irradiation effects. The data were classified according to the properties of ceramics. The properties are dimensional stability, mechanical property, thermal property and electrical and dielectric properties. The data sheets for each table or graph in the literatures were made. The characteristic feature of the data base was briefly described. As to swelling, the data were complied according to the dose dependence and the temperature dependence for each ceramics and reviewed briefly.

43498 (LBL—25004) Identification of periodic structure characterized from amorphous support by simulation and processing techniques. O'Keefe, M.A.; Sattler, M.L. (Lawrence Berkeley Lab., CA (USA)). Apr 1988. Contract AC03-76SF00098. 4p. (CONF-880841—17). NTIS, PC A02/MF A01; 1; GPO Dep. Order Number DE88010881/JAW.

From MAS/EMSA microbeam analysis conference; Milwaukee, WI, USA (7 Aug 1988).

High resolution electron images that suggest crystalline lattice fringes in a background of amorphous material are difficult to interpret. A new technique of image processing, referred to here as "background subtraction", was recently developed to enhance images of such crystalline particles supported on amorphous substrates. However, the interpretation of exact crystalline surfaces on the particle was not straightforward. We have now applied this enhancement technique, previously used on experimental images, to simulated images of small crystals of TiO_2 on amorphous substrates

of SiO_2. Additionally, other commonly-used processing techniques are introduced as comparisons for the "background subtraction" method to point out its advantage in defining particle shape and internal structure. 4 refs., 4 figs.

43499 **Further evidence for the presence of c = 38.2 A phase in a Bi-Ca-Sr-Cu-O superconductor.** Ramesh, R.; Hetherington, C.J.D.; Thomas, G.; Green, S.M.; Jiang, C.; Rudee, M.L.; Luo, H.L. (National Center for Electron Microscopy and Materials and Chemical Sciences Division, Lawrence Berkeley Laboratory, University of California, Berkeley, California 94720). *Applied Physics Letters;* **53**: No. 7, 615-617(15 Aug 1988).

Results of high-resolution electron microscopy, convergent beam electron microscopy, and x-ray microanalysis on the high T/ sub c/ phase are reported. Local inhomogeneities in the structure and composition have been observed along the c direction. Both c = 30.56 A (8a/sub p/) and c = 38.2 A (10a/sub p/) have been observed inside the same grain. The regions with the larger c parameter correspond to regions with higher Ca and Cu concentration suggesting that the range of transition temperatures observed (85 to 115 K) is due to the coexistence of such regions of c = 38.2 A and c = 30.56 A.

43500 **Nucleation and growth kinetics of the tetragonal to orthorhombic transition in YBa_2Cu_3O/sub 7-//sub partial/.** Shi, D.; Zhang, K.; Capone II, D.W. (Materials Science Division, Argonne National Laboratory, Argonne, Illinois 60439). *Journal of Applied Physics;* **64**: No. 4, 1995-1998(15 Aug 1988).

The nucleation and growth geometry of the tetragonal to orthorhombic transformation in YBa_2Cu_3O/sub x/ is determined to be grain-boundary nucleation after saturation. In this geometry the orthorhombic phase rapidly nucleates along the grain boundaries, then propagates into the grains as a planar front governed by the much slower volume diffusion of oxygen. This conclusion is reached by fitting the volume fraction of the superconducting, and hence orthorhombic, phase as a function of annealing time at 400 °C to the Avrami relation. The volume fraction of the superconducting phase is obtained using magnetization versus field data.

43501 **Structure and composition of the 115 K superconducting phase in the Bi-Ca-Sr-Cu-O system.** Ramesh, R.; Thomas, G.; Green, S.M.; Rudee, M.L.; Luo, H.L. (Department of Materials Science and Mineral Engineering and Materials and Chemical Sciences Division, Lawrence Berkeley Laboratory, University of California, Berkeley, California 94720). *Applied Physics Letters;* **53**: No. 6, 520-522(8 Aug 1988).

Results of convergent beam electron diffraction and energy dispersive x-ray (EDX) microanalysis of Bi/sub 1.2/Ca/sub 0.9/Sr/sub 0.9/Cu_2O/sub y/ superconductor are reported. The structure is orthorhombic with a = 5.63 A, b = 5.4 A, and c = 38.2 A. The c parameter is different from those reported by other workers and suggests that two extra perovskite units a/sub p/, where a/sub p/ = 3.82 A, have been introduced leading to c = 10a/sub p/. EDX microanalysis shows that the Cu content of this phase is higher than that reported by other workers. It is suggested that the phase with c = 38.2 A may be the higher temperature (115 K) superconductor.

43502 **Preparation of Bi-Sr-Ca-Cu-O superconductors from oxide-glass precursors.** Hinks, D.G.; Soderholm, L.; Capone D.W. II; Dabrowski, B.; Mitchell, A.W.; Shi, D. (Materials Sciences and Chemistry Divisions, Argonne National Laboratory, Argonne, Illinois 60439). *Applied Physics Letters;* **53**: No. 5, 423-425(1 Aug 1988).

In this letter we report on efforts to synthesize the new Ca-Sr-Bi-Cu-O superconductors from amorphous glasses. These glasses are produced by quenching melts of the constituent oxides, followed by firing to produce the superconducting phase. This synthetic route produces denser, more uniform samples than those obtained from firing intimate mixtures of the constituent binary oxides and carbonates. Ultimately, this technique may yield pure materials with enhanced bulk properties.

43503 **Sequential electron beam evaporated films of $Tl_2CaBa_2Cu_2O$/sub y/ with zero resistance at 97 K.** Ginley, D.S.; Kwak, J.F.; Hellmer, R.P.; Baughman, R.J.; Venturini, E.L.; Morosin, B. (Sandia National Laboratories, Albuquerque, New Mexico 87185). *Applied Physics Letters;* **53**: No. 5, 406-408(1 Aug 1988).

Thin unoriented polycrystalline films in the Tl-Ca-Ba-Cu-O system were prepared by sequential electron beam evaporation of multiple Tl, Ca, Ba, and Cu layers and a two-stage anneal under controlled Tl and oxygen overpressures. These films show zero resistance as high as 97 K and transport critical current densities at 76 K up to 110 000 A/cm^2 with typical values of 50 000 A/cm^2. The critical currents exhibit a modest magnetic field dependence. Meissner effect data show an onset at 110 K and a superconducting fraction of 75%. Compositional and structural studies indicate that the films, although polyphase, are predominantly $Tl_2Ca_1Ba_2Cu_2O$/sub y/. There is no evidence of other superconducting phases.

43504 **Annealing of damage and stability of implanted ions in ZnO crystals.** Sonder, E.; Zuhr, R.A.; Valiga, R.E. (Oak Ridge National Laboratory, Oak Ridge, Tennessee 37831-6030). *Journal of Applied Physics;* **64**: No. 3, 1140-1144(1 Aug 1988).

The annealing of Bi, Cr, and Mn, implanted in ZnO, has been studied by Rutherford backscattering, ion channeling, and secondary ion mass spectroscopy. Implantation of $\sim 10^{16}$ ions/cm^2 of any of these elements produces large concentrations of Zn interstitials, but no completely amorphous region. The temperature at which these interstitials anneal is a function of the implant species. Other defects produced by the implantation, which give rise to dechanneling and a consequent increased scattering probability in the tails of backscattering spectra, anneal at significantly higher temperature. This annealing is also a function of the implant species. Motion of the implant ions themselves does not occur when the interstitials anneal; it takes place above 700 °C for Bi and Mn, and above 1000 °C for Cr.

43505 **Photoemission and inverse photoemission studies of La adatom interactions with YBa_2Cu_3O/sub 6.9/.** Gao, Y.; Wagener, T.J.; Aldao, C.M.; Vitomirov, I.M.; Weaver, J.H.; Capone D.W. II. (Department of Chemical Engineering and Materials Science, University of Minnesota, Minneapolis, Minnesota 55455). *Journal of Applied Physics;* **64**: No. 3, 1296-1300(1 Aug 1988).

The surface reactions that occur when adatoms of La are deposited onto the high-temperature superconductor YBa_2Cu_3O/sub 6.9/ have been studied using high-resolution synchrotron radiation photoelectron spectroscopy and inverse photoelectron spectroscopy. These adatoms lead to the depletion of oxygen from the substrate as La-O forms at low coverage. The process of oxygen withdrawal quickly becomes kinetically limited as the thickening overlayer impedes mass transfer. At the same time, Cu atoms released from the disrupted, no-longer- superconducting substrate outdiffuse into, and segregate to the top of, the growing La overlayer. The complex reacted interface, therefore, exhibits phases which are likely to be superconducting, insulating, and metallic.

43506 **Infrared spectra in nonstoichiometric yttria-stabilized zirconia mixed crystals at elevated temperatures.** Liu, D.W.; Perry, C.H.; Ingel, R.P. (Department of Physics, Florida Atlantic University, Boca Raton, Florida 33431). *Journal of Applied Physics;* **64**: No. 3, 1413-1417(1 Aug 1988).

Infrared (IR) reflectivity measurements were undertaken on pure ZrO_2 and stabilized $ZrO_2xY_2O_3$ solid solutions containing 3-, 4-, 7-, 12-, and 20-wt.% Y_2O_3 over 10—900 cm^{-1} region as a function of temperature up to 1400 °C. The observed IR active phonons are related to the phase transitions that depend on composition and temperature. Good agreement was achieved among IR, Raman scattering, and neutron scattering investigations. An IR reflectivity enhancement from 42% to 60% in the low-frequency region (10—110 cm^{-1}) was found as the monoclinic(M)-tetragonal(T) martensitic transition was completed in pure ZrO_2 and ZrO_2x3-wt.% Y_2O_3.

43507 **Proton radiation damage in superconducting $EuBa_2Cu_3O$/sub x/ and $GdBa_2Cu_3O$/sub x/.** Willis, J.O.; Cooke, D.W.; Brown, R.D.; Cost, J.R.; Smith, J.F.; Smith, J.L.; Aikin, R.M.; Maez, M. (Los Alamos National Laboratory, Los Alamos, New Mexico 87545). *Applied Physics Letters;* **53**: No. 5, 417-419(1 Aug 1988).

Sintered samples of $EuBa_2Cu_3O$/sub x/ and $GdBa_2Cu_3O$/sub x/ with x≈7 have been irradiated at 90 °C with 800 MeV protons. The superconducting transition temperature decreases 1.7 K/10^{17} pcm^{-2} for both materials. The critical magnetization current density, characterizing intragranular conduction, increases a factor of 3 at zero field and relatively larger factors for finite magnetic fields at 7 and 75 K for fluences on the order of 10^{17} pcm^{-2}. No and only minor differences between irradiated and unirradiated specimens were seen in calorimetric and transmission electron microscopy analyses, respectively.

43508 **Defect generation in silicon dioxide from soft x-ray synchrotron radiation.** Williams, C.K.; Reisman, A.; Bhattacharya, P.; Ng, W. (Microelectronics Center of North Carolina, P. O. Box 12889, Research Triangle Park, North Carolina 27709). *Journal of Applied Physics;* **64**: No. 3, 1145-1151(1 Aug 1988).

Generation of fixed positive charge, neutral electron traps, and fixed negative charge in SiO_2 due to exposure to monochromatic x-ray radiation in the photon energy range from 300 to 1000 eV in a synchrotron source is reported upon. At a constant exposure level of 2 x 10^7 rads, the number of defects generated is approximately independent of x-ray photon energy. The generated defects, independent of x-ray radiation energy, show normal post-metal annealing characteristics.

43509 **Effects of high-fluence neutron irradiation on the superconducting properties of magnetron sputtered NbN films.** Gregshammer, P.; Weber, H.W.; Kampwirth, R.T.; Gray, K.E. (Atominstitut der O-dieresisterreichischen Universitaeten, A-1020 Vienna, Austria, and Max Planck Institut fuer Festkorperforschung, HML, F-38042 Grenoble, France). *Journal of Applied Physics;* **64**: No. 3, 1301-1306(1 Aug 1988).

Neutron irradiation experiments on sputtered NbN films up to a fluence of 10^{25} m^{-2} (E>0.1 MeV) are reported. Both the transition temperatures T/sub c/ and the normal state resistivities change only slightly with neutron fluence. While the critical current densities degrade (up to 30%) in an intermediate field range (6—14 T), the high field data show virtually no change of J/sub c/ due to the radiation-induced increase of B/sub c_2 and the occurrence of peak effects near the upper critical field. It is therefore proven experimentally that NbN is an extremely radiation-hard high field superconductor.

43510 **Specific heat and the number of components of the order parameter in the 90-K superconductors.** Brand, H.R.; Doria, M.M. (Center for Nonlinear Studies, Mail Stop B258, Los Alamos National Laboratory, Los Alamos, New Mexico 87545 and FB7, Physik, Universitaet Essen, D43 Essen 1, West Germany). *Physical Review Letters;* **61**: No. 4, 480-480(25 Jul 1988).

A Comment on the Letter by S. E. Inderhees et al., Phys. Rev. Lett. 60, 1178 (1988).

43511 **Inderhees et al. reply.** Inderhees, S.E.; Salamon, M.B.; Goldenfeld, N.; Rice, J.P.; Pazol, B.G.; Ginsberg, D.M.; Liu, J.Z.; Crabtree, G.W. (Department of Physics and Materials Research Laboratory, University of Illinois at Urbana-Champaign, Urbana, Illinois 61801). *Physical Review Letters;* **61**: No. 4, 481-481(25 Jul 1988).

The authors discuss their recent paper on the specific heat of single crystals of Y-Ba-Cu-O nesr the superconducting transition temperature. They conclude that the O(2) Ginzburg-Landau theory does not fit their data. (AIP)

43512 **Observation of phonon anomalies in the intermediate-valence compound $CePd_3$.** Severing, A.; Reichardt, W.; Holland-Moritz, E.; Wohlleben, D.; Assmus, W. (Material Science and Technology Division, Los Alamos National Laboratory, Los Alamos, New Mexico 87545). *Physical Review [Section] B: Condensed Matter;* **38**: No. 3, 1773-1778(15 Jul 1988).

We report measurements of the phonon dispersion relation in intermediate-valence $CePd_3$. The longitudinal-acoustic modes show a distinct softening above 100 K and a temperature-dependent broadening and splitting at higher temperatures. Especially in the <100> direction the longitudinal modes differ from those of other Cu_3Au structures. A good fit of the room-temperature dispersion curves is given by a 16-parameter Born—von Karman model with a breathing force as an additional degree of freedom.

43513 **Transient homologous structures in nonstoichiometric YBa_2Cu_3O/sub 7-//sub x/.** Khachaturyan, A.G.; Morris, J.W. Jr. (Center for Advanced Materials, Lawrence Berkeley Laboratory, Berkeley, California 94720). *Physical Review Letters;* **61**: No. 2, 215-218(11 Jul 1988).

It is proposed that a homologous series of transient ordered structures may form during the spinodal decomposition of the nonstoichiometric superconducting oxide YBa_2Cu_3O/sub 7-//sub x/. These transient phases provide the best kinetic accommodation of the local vacancy concentration. Their structures should be similar to those of the Ti/sub m/O_2/sub m//sub -1/ and Mo/sub m/O_3/sub m//sub -1/ series of Magneli phases. The transient phases in the oxide have the stoichiometry YBa_2Cu_3O/sub 7-//sub n//sub /(2// sub n//sub +1)/, where n is an integer. The structure of the n phase has a diffraction maximum at the point (n/(2n+1)0 0). Examples have been experimentally observed.

43514 **Magnetic correlations in La_2NiO/sub 4+//sub δ/.** Aeppli, G.; Buttrey, D.J. (AT&T Bellp Laboratories, 600 Mountain Avenue, Murray Hill, New Jersey 07974). *Physical Review Letters;* **61**: No. 2, 203-206(11 Jul 1988).

We report neutron-scattering experiments on single crystals of the layered perovskite La_2NiO/sub 4+//sub δ/. Three-dimensional magnetic order sets in at T/sub N/ = 70 K for δ≈0.05. Strong two-dimensional magnetic correlations exist for T between T/sub N/ and the tetragonal-to-orthorhombic transition temperature, T/sub S/≈240 K. As T is increased through T/sub S/, the 2D correlation length decreases from more than 50 to 10 A. The excitation spectra for the 3D ordered state are characterized by large effective in-plane spin-wave velocities which, like T/sub N/, depend strongly on δ: For δ = 0 +- 0.001, capprox. >0.2 eV-A, while for δ = 0.05, c≈0.1 eV-A.

43515 **Lattice instability and soft phonons in single-crystal La/sub 2-//sub x/Sr/sub x/CuO_4.** Boeni, P.; Axe, J.D.; Shirane, G.; Birgeneau, R.J.; Gabbe, D.R.; Jenssen, H.P.; Kastner, M.A.; Peters, C.J.; Picone, P.J.; Thurston, T.R.; and others. (Brookhaven National Laboratory, Upton, New York 11973). *Physical Review [Section] B: Condensed Matter;* **38**: No. 1, 185-194(1 Jul 1988).

The dispersion of the low-lying phonon branches of several doped and undoped single crystals of La/sub 2-//sub x/Sr/sub x/CuO_4 have been investigated by using inelastic-neutron-scattering techniques. The zone-center modes are in good agreement with Raman measurements. The reported peaks in the phonon density of states show up at energies that correspond to extrema in the dispersion curves of the transverse and longitudinal acoustic branches near the zone boundary. The tetragonal-to-orthorhombic phase transition is caused by a softening of transverse-optic-phonon mode at the X point. The rotational nature of the soft mode leads to moderate weak electron-phonon coupling and the mode is unlikely to enhance significantly conventional phonon mediated superconductivity. We did not observe any evidence for the predicted breathing-mode instability near the zone boundary.

43516 Disruption, segregation, and passivation for Pd and noble-metal overlayers on YBa_2Cu_3O/sub 6.9/. Wagener, T.J.; Gao, Y.; Vitomirov, I.M.; Aldao, C.M.; Joyce, J.J.; Capasso, C.; Weaver, J.H.; Capone II, D.W. (Department of Chemical Engineering and Materials Science, University of Minnesota, Minneapolis, Minnesota 55455). *Physical Review [Section] B: Condensed Matter;* **38**: No. 1, 232-239(1 Jul 1988).

We have investigated interfaces formed when Pd and the noble metals Cu, Ag, and Au are deposited onto polycrystalline samples of YBa_2Cu_3O/sub 6.9/ fractured in ultrahigh vacuum. Synchrotron-radiation photoemission results show that Cu and Pd overlayers leach oxygen from the underlying YBa_2Cu_3O/sub 6.9/ substrate, disrupt the superconductor, and destroy electronic states near the Fermi level. Interface reactions become kinetically limited at room temperature after the deposition of ~4 A of Cu or Pd, significantly sooner than for the reactive metals Fe, Al, Ti, and In. The presence of Ba near the surface after the deposition of more than 100 A of Cu and Pd reflects substrate disruption and subsequent surface segregation. In contrast, overlayers of Ag and Au do not disrupt the superconductor substrate, no segregation is observed, but the overlayers are nonuniform and the quality of passivation is in question for coverages <100 A.

43517 Orientation-dependent x-ray-absorption near-edge studies of high-T/sub c/ superconductors. Heald, S.M.; Tranquada, J.M.; Moodenbaugh, A.R.; Xu, Y. (Department of Applied Science, Brookhaven National Laboratory, Upton, New York 11973). *Physical Review [Section] B: Condensed Matter;* **38**: No. 1, 761-764(1 Jul 1988).

Orientation-dependent x-ray-absorption near-edge measurements have been made on the Cu and Y K edges in oriented $La_{1.85}Sr_{0.15}CuO_4$ and $YBa_2Cu_3O_{7-x}$ superconductors. The orientation dependence of the Cu edges is quite similar to that for other Cu^{2+} planar compounds, and allows a clear identification of a number of near-edge features. The results also demonstrate the strong similarity of the Cu-O planes in the two materials, and clearly establish that Cu^{1+} is being formed on the linear-chain sites for $x = 0.77$.

43518 Systematic variation of magnetic-field penetration depth in high-T/sub c/ superconductors studied by muon-spin relaxation. Uemura, Y.J.; Emery, V.J.; Moodenbaugh, A.R.; Suenaga, M.; Johnston, D.C.; Jacobson, A.J.; Lewandowski, J.T.; Brewer, J.H.; Kiefl, R.F.; Kreitzman, S.R.; and others. (Brookhaven National Laboratory, Upton, New York 11973). *Physical Review [Section] B: Condensed Matter;* **38**: No. 1, 909-912(1 Jul 1988).

The muon-spin relaxation rate σ has been measured in the high-T/sub c/ superconductors $YBa_2Cu_3O_x$ for $x = 6.66$, 6.95, 7.0, and $La_{1.85}Sr_{0.15}CuO_4$ in transverse external magnetic fields ~1—4 kG. We find a simple relation which connects transition temperature T/sub c/, the magnetic-field penetration depth λ/sub L/, the carrier concentration n/sub s/, and the effective mass m/sup */ as $T_c \propto \sigma \propto 1/\lambda_L^2 \propto n_s/m^*$. The linear dependence $T_c \propto n_s/m^*$ suggests a high-energy scale for the coupling between superconducting carriers.

43519 Electronic structure studies of La_2CuO_4. Wachs, A.L.; Turchi, P.E.A.; Jean, Y.C.; Wetzler, K.H.; Howell, R.H.; Fluss, M.J.; Harshman, D.R.; Remeika, J.P.; Cooper, A.S.; Fleming, R.M.; and others. (Lawrence Livermore National Laboratory, Livermore, California 94550). *Physical Review [Section] B: Condensed Matter;* **38**: No. 1, 913-916(1 Jul 1988).

We report results of positron-electron momentum-distribution measurements of single-crystal La_2CuO_4 using two-dimensional angular correlation of positron-annihilation-radiation techniques. The data contain two components: a large (~85%), isotropic core-like electron contribution and a remaining, anisotropic valence-electron contribution modeled using a linear combination of atomic orbitals—molecular orbital method and a localized ion scheme, within the independent-particle model approximation. This work suggests a ligand-field Hamiltonian to be justified for describing the electronic properties of perovskite materials.

43520 Method for the preparation of protective coatings by low-temperature metal—organic chemical vapor deposition (MOCVD). Kaloyeros, A.E.; Williams, W.S.; Constant, G. (Department of Physics and Materials Research Laboratory, University of Illinois at Urbana-Champaign, Urbana, Illinois 61801). *Review of Scientific Instruments;* **59**: No. 7, 1209-1214(Jul 1988).

A simple and effective method is reported for the deposition of protective coatings of titanium carbide using low-temperature (as low as 150 °C) metal—organic chemical vapor deposition. This method is based on the thermolysis of metal—organic molecules containing titanium and does not require the high temperature (<1100 °C) involved in the standard TiC—CVD technique. Furthermore, the structure of the films produced (crystalline or amorphous) and their purity (inclusion of organic clusters or hydrogen) can be tailored easily by simple variations in the deposition parameters. This technique permits the coating of polymers and low-melting metals that are thermally too fragile for other deposition techniques. The process could be applied to produce films of other materials, e.g., niobium carbide, silicon carbide, titanium diboride, and gallium arsenide.

43521 Effect of agglomerate strength on sintered density for yttria powders containing agglomerates of monosize spheres. Ciftcioglu, M.; Akine, M.; Burkhart, L. (Ames Lab. and Departments of Chemical Engineering and Materials Science and Engineering, Iowa State Univ., Ames, IA (US)). *Journal of the American Ceramic Society;* **70**: No. 11, C329-334(Nov 1987).

The effect of agglomerate strength on sintered density was determined for several yttria powders made by intentionally agglomerating 0.1-μm, monodisperse yttriuim hydrocarbonate precursor spheres and calcining separate portions of the precursor at different temperatures to vary the strength of the intraaglomeate bonds. In this way, the effects of differences in particle morphology and other characteristics among the powders were minimized and the effect of agglomerate strength could be seen more clearly.

43522 Fabrication of YBa/sub 2/Cu/sub 3/O/sub 7/ superconducting ceramics. Poeppel, R.B.; Flandermeyer, B.K.; Dusek, J.T.; Bloom, I.D. (Materials and Components Technology Div., Argonne National Lab., Argonne, IL (US)). pp 261-265 of Chemistry of high-temperature superconductors. Nelson, D.L.; Whittingham, M.S.; George, T.F. Washington, DC; American Chemical Society (1987). (CONF-8708179—).

From Symposium on the chemistry of high temperature superconductors; New Orleans, LA, USA (30 Aug 1987).

Recent experience concerning the preparation of YBa/sub 2/Cu/sub 3/O/sub 7/ powder and its fabrication into a variety of shapes is detailed. The fabrication techniques used were dry pressing, tape casting, and extrusion. Parameters found to affect superconductor quality are noted.

43523 High-temperature superconductors: Occupied and unoccupied electronic states, surface stability, and interface formation. Gao, Y.; Wagener, T.J.; Hill, D.M.; Meyer, H.M. III; Weaver, J.H.; Arko, A.J.; Flandermeyer, B.K.; Capone, D.W. II. (Dept. of Chemical Engineering and Materials Science, Univ. of Minnesota, Minneapolis, MN (US)). pp 212-227 of Chemistry of high-temperature superconductors. Nelson, D.L.; Whittingham, M.S.; George, T.F. Washington, DC; American Chemical Society (1987). (CONF-8708179—).

From Symposium on the chemistry of high temperature superconductors; New Orleans, LA, USA (30 Aug 1987).

The energy distribution of the occupied and unoccupied electronic states of the high temperature superconductors $La_{1.85}Sr_{0.15}CuO_4$ and $YBa_2Cu_3O_{6.9}$ have been identified using x-ray photoemission and inverse photoemission. These results show low state density within several eV of the Fermi energy, E_F, well-defined Cu-O occupied levels —4 eV below E_F, and the Ba, Y, and La states above E_F. Chemisorption of oxygen produces a structure —1.6 eV above E_F, and high energy electron bombardment eliminates this

structure for La/sub 1.85/Sr/sub 0.15/CuO/sub 4/ but not for YBa/sub 2/Cu/sub 3/O/sub 6.9/. The deposition of Fe overlayers on La/sub 1.85/Sr/sub 0.15/CuO/sub 4/ reduces the emission within —3 eV of E/sub F/, indicating disruption of the hybrid Cu 3d/sub x/2/sub -y/2 - O 2p/sub x,y/ states responsible for superconductivity. Fe adatoms also selectively alter the chemical states of Cu, quenching the Cu/sup 2+/ configuration and leaving the surface region in a Cu/sup 1+/ configuration. The growth of a thicker film results in the burial of the region containing Fe-O and the disrupted superconductor, although there continues to be evidence for O in solution in the Fe film.

3606 Other Materials

REFER ALSO TO CITATION(S) 42720, 42752, 42774, 42928, 42929, 43005, 43006, 43009, 43061, 43396, 43434, 43672, 43675, 43683, 43684, 43744, 44305, 44306, 44374

43524 (DOE/ER—45111-3) Analysis of microphase separation in ion-containing polymers: Final report for period July 1, 1984-December 31, 1986. Cooper, S.L. (Wisconsin Univ., Madison (USA). Dept. of Chemical Engineering). Mar 1988. Contract FG02-84ER45111. 30p. NTIS, PC A03/MF A01;1; GPO Dep. Order Number DE88008570/JAW.

Ionomers, polymers containing a small amount of ionic comonomer, possess interesting theoretical and mechanical properties. The ionic groups tend to aggregate in these materials, forming a microphase-separated structure with a continuous polymer matrix and dispersed ionic aggregates. We have developed a morphological model for the aggregates' shape and arrangement, which provides an excellent fit to small-angle x-ray scattering (SAXS) data from several systems. Sulfonated and carboxylated polystyrenes, ethylene/methacrylic acid, and sulfonated ethylene-propylene-diene rubber ionomers were investigated by SAXS as a function of acid content, temperature, and water content. The model parameters suggested that the layer of hydrocarbon material coating the ionic aggregates, which controls the minimum interaggregate separation, is approximately 0.7 nm for all polystyrene samples regardless of ion content, but that this parameter varies with the polymer backbone type. Extended x-ray absorption fine structure (EXAFS) spectroscopy was used to examine the coordination structure surrounding the cations in several ionomers. A sample of zinc-neutralized sulfonated polystyrene dried under vigorous conditions was found to exhibit a well-defined coordination structure closely resembling that of low-molecular-weight crystalline model compounds. However, the local structure observed depended strongly on the cation type and thermal history of the materials. 12 refs., 6 figs., 4 tabs.

43525 (DP-MS—87-77) Pourbaix diagram for the prediction of waste glass durability in geologic environments. Jantzen, C.M. (Du Pont de Nemours (E.I.) and Co., Aiken, SC (USA). Savannah River Plant). 1987. Contract AC09-76SR00001. 13p. (CONF-871124—98). NTIS, PC A03/MF A01;3. Order Number DE88008323/JAW.

From Fall meeting of the Materials Research Society; Boston, MA, USA (30 Nov 1987).

Dissolution of nuclear waste glass occurs by corrosion mechanisms similar to those of metallurgical and mineralogic systems albeit on different time scales. The effects of imposed pH and oxidation potential (Eh) conditions existing in natural environments on metals and minerals have been quantitatively and phenomenologically described in compendiums of Pourbaix (pH-potential) diagrams. Construction of Pourbaix diagrams to quantify the response of nuclear waste glasses to repository specific pH and Eh conditions is demonstrated. The expected long-term effects of groundwater contact on the durability of nuclear waste glasses can then be unified. 40 refs., 4 figs., 1 tab.

43526 (ETSU-N—109, pp 141-147) Cost effective, large advanced composites. Whiley, D.A. (Structural Polymer Systems Ltd., Cowes (GB)). 1988. NTIS (US Sales Only), PC A08. Order Number DE88753394/JAW. (CONF-8711186—).

From Use of composite materials for wind turbines workshop; Harwell, UK (4 Nov 1987).

This paper presents examples of the application of advanced composites in other industries for large, high performance structures, and discusses their relevance to the use of advanced composites in wind turbines. Possible materials include wood, glass, aramid and carbon, as well as various core materials. Current methods of design and analysis are reviewed with reference to optimisation of structural performance and cost. Recent developments are presented including new reinforcements for production, epoxy laminating systems optimised for large layups, and low temperature epoxy prepreg systems for improved quality and reduced layup time. Production techniques have been developed in parallel with the new materials. Integrally heated moulds are being developed for use with the low temperature pre-preg system. Finally, areas are highlighted where further work is required to match the materials, technology and design codes to the specific needs of the wind turbine industry.

43527 (JAERI-M—87-207) Effects of high temperature neutron irradiation on dimensional changes and physical properties of nuclear graphites for HTGR. Matsuo, Hideto. (Japan Atomic Energy Research Inst., Tokyo). Jan 1988. 78p. (In Japanese). NTIS (US Sales Only), PC A05/MF A01. Order Number DE88753422/JAW.

Ten kinds of polycrystalline graphites and carbon materials, including nuclear graphites, were irradiated in JMTR up to a maximum neutron fluence of 2.84 x 10^{25} nm^2 (E > 29 fJ) at 800 - 1335 deg C, and effects of neutron irradiation on dimensional changes, volume, bulk density, thermal expansivity, thermal conductivity, electrical resistivity, and Young's modulus were studied. Macroscopic dimensional shrinkages were observed for all samples except for POCO graphite. The shrinkage rates showed the smallest value at irradiation temperature of around 850 deg C and lager values at below and above 850 deg C as well. Coefficient of thermal expansion increased in the initial small range of neutron fluence, followed by decrease with neutron fluence. After irradiation, thermal conductivity decreased and electrical resistivity and Young's modulus increased. The changes in the initial small range of neutron fluence were larger for the case of lower irradiation temperatures. The results were compared with the experimental results obtained from irradiation in HFR.

43528 (JSS-TR—87-02) Nuclear waste glass dissolution: Mechanism, model and application. Report to the JSS-project phase IV. Grambow, B. (Swedish Nuclear Fuel and Waste Management Co., Stockholm; Hahn-Meitner-Institut fuer Kernforschung Berlin G.m.b.H. (Germany, F.R.)). Oct 1987. 121p. NTIS (US Sales Only), PC A06/MF A01. Order Number DE88754186/JAW.

The glass corrosion behavior is described in terms of a mechanism, which is based on glass network breakdown and takes saturation effects, surface layer formation, diffusion processes, and changes in solution composition into account. The theoretical treatment of the glass/water reaction is based on transition state theory in combination with reversible and irreversible thermodynamics. Recent progress in the field of rock/water interaction has been applied to the theory of glass dissolution. A computer program is used (GLASSOL) to calculate the glass/water reaction. Input variables are glass and solution composition, time, temperature, glass surface area, solution volume, and flow rate. Rate and stability constants are required which can easily be determined by experiments.

43529 (LA—11271-MS) Potential foams and metal foils for cosmic dust capture. Wrobleski, D.A.; Abel, K.H.; Gray, A.J.; Williams, J.M. (Los Alamos National Lab., NM (USA)). Jul 1988. Contract W-7405-ENG-36. 44p. NTIS, PC A03/MF A01; 1; GPO Dep. Order Number DE88012960/JAW.

The scientific detection of cosmic dust particles will provide information about their astrophysical source and velocity. A suitable capture medium will preserve the particles in such a state (not necessarily the state just before capture) that their intrinsic chemical, mineral, and/or biological information can be determined. Foam and stacked, thin foil arrays provide the best current technology for effecting this capture. This paper presents physical and chemical data about a number of commercial and experimental foams and metal foils that could potentially be used to capture cosmic dust particles. The most promising foams are polystyrene-based: bead, extruded, and emulsion-polymerized. The most promis-

ing foils are those made of beryllium, aluminum, or gold. 30 refs., 1 fig., 6 tabs.

43530 **(MLM—3514) Preparation of fibrous palladium.** Silver, G.L.; Seabaugh, P.W.; Leahy, B.T.; Werkmeister, D.W.; Martin, F.S.; Friedlander, H.N. (Monsanto Research Corp., Miamisburg, OH (USA). Mound). 15 Jun 1988. Contract AC04-76DP00053. 32p. NTIS, PC A03/MF A01; 1; GPO Dep. Order Number DE88013799/JAW.

Acrylic fibers (pan fibers) absorb palladium from a hot solution of palladium nitrate in nitric acid. When palladium-loaded acrylic fibers are burned, fibers consisting of palladium and palladium oxide are formed. Reduction of this mixture with hydrogen produces fibers of palladium metal. The fibers may be compressed into pellets which offer less resistance to flowing hydrogen than similar pellets prepared by compressing commercial palladium powder. 9 refs., 12 figs., 5 tabs.

43531 **(RISO-M—2670) Shear and flexure properties of composite materials.** Lilholt, H. (Risoe National Lab., Roskilde (Denmark)). Oct 1987. 63p. (In Danish). NTIS (US Sales Only), PC A04/MF A01. Order Number DE88752085/JAW.

The report summarises three reports, covering the following subjects The recommended specimen dimensions are given for tensile and shear testing of fibrous composite materials with +- θ fibre orientation. The data for glassfibre/polyester and for carbonfibre/epoxy are given for tensile and shear properties: A test method is described, which allows simultaneous measurement of tensil and shear behaviour, through a three point bending technique; this type of loading imposed both tensile and shear deformations in the material. Examples are given to illustrate the method.

43532 **(SAND—87-2294C) Evaluation and control of residual states in curved, composite panels.** Reuter, R.C. Jr. (Sandia National Labs., Albuquerque, NM (USA)). 1988. Contract AC04-76DP00789. 11p. (CONF-8806164—1). NTIS, PC A 03; 3; GPO Dep. Order Number DE88012103/JAW.

From 4. Japan-U.S. conference on composite panels; Washington, DC, USA (27 Jun 1988).

Analytical techniques were employed to characterize residual effects induced in laminated, curved, composite panels during fabrication processing. The analysis was utilized to predict the radius of a mold upon which panels could be fabricated so that they deform, upon release from the mold, to a predetermined radius of curvature. Sample panels were fabricated which provided experimental data and partial verification of the analytical methods developed.

43533 **Study of plasma-film interactions in He/H_2, Ar/H_2, and Xe/H_2 radio frequency sputtered a-Si:H.** Albers, M.L.; Shinar, J.; Shanks, H.R. (Ames Laboratory: US Department of Energy and Department of Physics, Iowa State University, Ames, Iowa 50011). *Journal of Applied Physics;* **64**: No. 4, 1859-1872(15 Aug 1988).

A study of plasma-film interactions present during the deposition process of a-Si:H prepared by radio frequency (rf) sputtering in 10 mTorr of either He, Ar, or Xe and 0.5 mTorr H_2, at rf power levels of 0.27—3.3 W/cm^2 (50—600 W), on nominally unheated substrates, is presented. Measurement techniques included scanning electron microscopy (SEM), infrared (IR) and optical absorption, and electron-spin resonance (ESR). The SEM images indicated that the films prepared in He/H_2 at low power are morphologically porous and/or columnar; the evidence suggests that as the rf power is increased, the islands coalesce to form larger ones and the images appear glassy and cracked. IR

43534 **Studies of lattice distortion and crystal curvature in arsenic-implanted silicon.** Kuo, C.L.; Kao, Y.H.; Arnold, E.; Bilello, J.C. (School of Engineering and Computer Science, California State University, Fullerton, California 92634). *Journal of Applied Physics;* **64**: No. 4, 1791-1794(15 Aug 1988).

The lattice distortion and crystal curvature in arsenic-implanted silicon wafers are investigated using a technique of double-crystal topography. In this study, a method for quantitative determination of the curvature of asymmetric crystal reflection planes as well as the concavity of specimens is demonstrated. Measurements of samples with different arsenic-implantation fluences indicate that all the crystal surfaces are convex and the radius of curvature decreases with increasing arsenic fluence. Effects of thermal annealing are shown to result in a reduction of the crystal curvature and local lattice distortion.

43535 **X-ray diffraction study of a Langmuir monolayer of $C_{21}H_{43}OH$.** Barton, S.W.; Thomas, B.N.; Flom, E.B.; Rice, S.A.; Lin, B.; Peng, J.B.; Ketterson, J.B.; Dutta, P. (Department of Chemistry and The James Franck Institute, University of Chicago, Chicago, Illinois 60637). *Journal of Chemical Physics;* **89**: No. 4, 2257-2270(15 Aug 1988).

We have studied the structure of a monolayer of $C_{21}H_{43}OH$ on water, in the region near close packing, by grazing incidence in-plane x-ray diffraction. For all temperatures studied the isotherms in the πa plane show a kink, signaling a phase transition. Along an isotherm, and for pressures above the kink, we observe that the transverse structure factor has one peak which has constant position, width, and intensity; below the kink the diffraction peak shifts to smaller scattering vector (larger separation) and the amplitude decays as the surface pressure decreases, but the width of the peak remains constant. We rationalize these observations in terms of the influence on the transverse structure factor of gauche configurations in the amphiphile tails, with the kink representing the point at which the last of the gauche configurations is squeezed out of the chain. Along an isobar which is at higher pressure than the kink pressures of all isotherms crossed, the transverse structure factor has a single peak above a transition temperature and two peaks below that temperature; for $\pi = 30$ dyn/cm the transition temperature is in the range $16.3 < T < 21.3$ °C. We interpret this observation, by comparison with the properties of the lamellar crystalline n-paraffins, as a hexagonal-to-pseudohexagonal structural transition analogous to the crystal rotator II-to-rotator I transition. Our results imply that the hydrocarbon tails of the amphiphile molecules dominate the properties of the monolayer.

43536 **Minority-carrier lifetime in GaAs thin films.** Ahrenkiel, R.K.; Dunlavy, D.J.; Benner, J.; Gale, R.P.; McClelland, R.W.; Gormley, J.V.; King, B.D. (The Solar Energy Research Institute, Golden, Colorado 80401). *Applied Physics Letters;* **53**: No. 7, 598-599(15 Aug 1988).

Double-heterostructure devices of type Al/sub x/Ga/sub 1-//sub x/As/GaAs have been fabricated in thin films grown by the cleavage of lateral epitaxial film for transfer process. The electron lifetime in the p-type GaAs is measured by photoluminescence and found to be 32 ns at the 5 x 10^{16} cm^{-3} doping level. This is the largest reported lifetime for a freestanding GaAs thin film.

43537 **Thermal-wave imaging of epoxy/aluminum interfaces.** No, K.; McClelland, J.F. (Center for Nondestructive Evaluation and Ames Laboratory, U.S. Department of Energy, Iowa State University, Ames, Iowa 50011). *Journal of Applied Physics;* **64**: No. 4, 1730-1735(15 Aug 1988).

Laser-excited thermal-wave image magnitude and phase were acquired by photoacoustic detection in the 10—1000-Hz modulation frequency range on epoxy/aluminum interface systems with surface (black) and bulk (white) laser-absorbing epoxy, different planar interface distances, surface and subsurface flaws, and different surface angle boundaries. The following conclusions were reached from the thermal-wave results: (1) thermally thin epoxy on aluminum layer thicknesses can be estimated from variable modulation frequency data; (2) planar and subsurface defect interface structures of epoxy/aluminum systems are best studied by examining both magnitude and phase images; (3) thermal-wave images are more straightforward to interpret for the systems that absorb light at the irradiated surface rather than in the bulk. These conclusions are consistent with thermal diffusion length and thermal-wave reflection effects predicted by theory for surface light-absorption conditions.

43538 HgI_2 near-band-gap photoluminescence structure and its relationship to nuclear detector quality. Wong, D.; Schlesinger, T.E.; James, R.B.; Ortale, C.; van den Berg, L.; Schnepple, W.F. (Department of Electrical and Computer Engineering, Carnegie Mellon University, Pittsburgh, Pennsylvania 15213). *Journal of Applied Physics;* **64**: No. 4, 2049-2053(15 Aug 1988).

The low-temperature photoluminescence spectra of several mercuric iodide detectors and off-stoichiometric bulk material have been characterized. Phonon energies have been determined with Raman spectroscopy over a range of temperatures. In earlier work some of the near-band-gap photoluminescence features were identified as phonon replicas. After careful examination of Raman and photoluminescence data, we find that one or perhaps more of these features is probably due to shallow electronic levels related to native defects. Suggestions as to the relationship between photoluminescence peaks and detector quality are made.

43539 Polymer/metal interfaces studied by carbon near-edge x-ray absorption fine structure spectroscopy. Jordan-Sweet, J.L.; Kovac, C.A.; Goldberg, M.J.; Morar, J.F. (IBM T. J. Watson Research Center, Box 218, Yorktown Heights, New York 10598). *Journal of Chemical Physics;* **89**: No. 4, 2482-2489(15 Aug 1988).

Interaction of polyimide and two simple organic polymers with an evaporated chromium metal overlayer was studied by surface-sensitive carbon 1s near-edge x-ray absorption fine structure (NEXAFS) spectroscopy. The technique was used to measure unoccupied electronic states in the polymers. Assignments of $C1s \rightarrow \pi^*$ transitions in poly(pyromellitimido oxydianiline) (PMDA-ODA polyimide) were based upon transitions measured for model polymers which contained structural subunits of the polyimide. Changes in the NEXAFS spectrum of each polymer were observed after sequential depositions of chromium. Abrupt changes in the carbonyl $C1s \rightarrow \pi^*$ transition peaks show that the carbonyl groups on these polymers are sites for initial interaction with chromium. No evidence was seen for the formation of Cr—arene complexes on any of the polymer surfaces.

43540 Interfacial defect creation by interstitial lithium doping of amorphous hydrogenated silicon. Winer, K.; Street, R.A. (Xerox Palo Alto Research Center, 3333 Coyote Hill Road, Palo Alto, California 94304). *Applied Physics Letters;* **53**: No. 6, 505-507(8 Aug 1988).

We study interstitial doping in amorphous hydrogenated silicon (a-Si:H) by indiffusion of lithium at 230 °C using secondary ion mass spectrometry, photothermal deflection spectroscopy (PDS), and electron spin resonance. Lithium is distributed nonuniformly in the films with peak concentrations within 300 nm of either interface. Lithium doping introduces up to 10^{18} paramagnetic defects per cc in a-Si:H ($g = 2.0061$, ΔH/sub p.p./ $= 5.2$ G), equal to the concentration of deep defects created as measured by PDS. The nature of these defects is discussed.

43541 Passivation of paramagnetic Si-SiO_2 interface states with molecular hydrogen. Brower, K.L. (Sandia National Laboratories, Albuquerque, New Mexico 87185-5800). *Applied Physics Letters;* **53**: No. 6, 508-510(8 Aug 1988).

Dry thermal oxides were grown on (111) silicon substrates at 850 °C. The P/sub b/ centers associated with this (111) Si-SiO_2 interface were observed with electron paramagnetic resonance to be stable under subsequent annealing in vacuum up to at least 850 °C. The rate of passivation of P/sub b/ centers with H_2 was observed to be proportional to the concentration of H_2 in the oxide and the density of P/sub b/ centers. The forward reaction rate constant k/sub f/ is temperature dependent and obeys the Arrhenius relationship having an activation energy E/sub f/ of 1.66 +- 0.06 eV and a pre-exponential factor k_0/sub f/ of 1.94 (+2./-1.) x 10/sup -6/ cm^3 /s for temperatures at least between 230 and 260 °C. The linear H_2 pressure dependence in the rate of passivation and the magnitude of k_0/sub f/ are reasonably consistent with a model in which the H_2 molecule reacts directly with P/sub b/ centers during its diffusional motion among the interstices of the SiO_2 network and the reaction site at P/sub b/ centers.

43542 Transient photocapacitance and photocurrent studies of undoped hydrogenated amorphous silicon. Gelatos, A.V.; Mahavadi, K.K.; Cohen, J.D.; Harbison, J.P. (University of Oregon, Eugene, Oregon 97403). *Applied Physics Letters;* **53**: No. 5, 403-405(1 Aug 1988).

We have applied transient photocapacitance and transient junction photocurrent measurements to the study of undoped hydrogenated amorphous silicon (a-Si:H) films, and find that the electronic optical transition from the dominant deep defect is very similar in energy to the $D^- \rightarrow D^0 + e$ optical transition identified in n-type doped a:Si:H films. In addition, we have observed a competing hole thermal transition, and we have obtained estimates of its thermal emission rate and of the thermal gap. We have used the difference between photocapacitance and photocurrent in the valence-band tail region to determine the quantity (μtau)/sub h/N/sub T/ at different temperatures. Finally, we have observed that light-induced metastable defects have a hole capture cross section significantly larger than that of the intrinsic defects.

43543 Thermal stability of aluminum-tin-oxide thin-film interface. Eser, E.; Ramos, F.; Grez, J. (Chronar Corp., P. O. Box 177, Princeton, New Jersey 08540). *Journal of Applied Physics;* **64**: No. 3, 1238-1244(1 Aug 1988).

Thermal stability of an Al/SnO_2 contact was investigated in the temperature range of 120—166 °C. Contact resistance measurements showed that the degradation in a neutral ambient or in clean and dry air follows two different regime. At early stages contact resistance increases exponentially with the square root of time, possibly indicating the presence of a tunneling type of current flow through the interface. Activation energy for this process was found to be 0.91 eV. At later stages the contact resistance increases proportionally to the square root of time. In humid air catastrophic failure of the contact was observed. The degradation in this case was found to be more than two orders of magnitude higher compared to the degradation in dry or neutral ambient. In all cases, a 100-A Ti barrier layer was found to virtually stop the degradation under the circumstances investigated in the present work. Auger electron spectroscopy analysis showed that the degradation of the contact is due to the diffusion of Al into the SnO_2 film and the subsequent reduction of SnO_2, resulting in the formation of Al_2O_3/metallic Sn mixture at the interface. The Ti barrier layer prevents the degradation process by acting as a diffusion barrier for Al.

43544 Reflection mass spectrometry of As incorporation during GaAs molecular beam epitaxy. Tsao, J.Y.; Brennan, T.M.; Hammons, B.E. (Sandia National Laboratories, Albuquerque, New Mexico 87185). *Applied Physics Letters;* **53**: No. 4, 288-290(25 Jul 1988).

An apertured and cryoshrouded mass spectrometer, which measures line-of-sight molecular fluxes from the surface, has been incorporated into a GaAs molecular beam epitaxy system. The spectrometer is simple to implement, yet is a powerful real-time growth diagnostic. We have used the spectrometer to measure transient and steady-state As incorporation from As_4 during bilayer-by-bilayer growth of GaAs. We find, interestingly, that (1) the incorporation coefficient does not oscillate significantly; (2) transient incorporation coefficients depend on surface reconstruction, and may be higher than 0.5 at high Ga fluxes; and (3) in the absence of a Ga flux, excess Ga on the surface need not imply an incorporation coefficient of 0.5.

43545 Melting in two dimensions: The ethylene-on-graphite system. Larese, J.Z.; Passell, L.; Heidemann, A.D.; Richter, D.; Wicksted, J.P. (Brookhaven National Laboratory, Upton, New York 11973). *Physical Review Letters;* **61**: No. 4, 432-435(25 Jul 1988).

Elastic and quasielastic neutron-scattering results for the melting of submonolayer ethylene films on graphite are described and microscopic evidence is presented for a continuous melting transition. Comparisons are made with data for equivalent methane films and with molecular-dynamics simulations. Differences in melting behavior are attributed to different vacancy creation mechanisms in the films.

43546 Critical dynamics of the sol-gel transition. Martin, J.E.; Wilcoxon, J.P. (Sandia National Laboratories, Albuquerque, New Mexico 87185). *Physical Review Letters;* **61**: No. 3, 373-376(18 Jul 1988).

The dynamics of the sol-gel transition is probed by use of quasielastic light scattering. A type of critical dynamics is observed that is associated with a divergent friction, rather than a singularity in a thermodynamic quantity. Several novel effects are reported, including power-law time decay of the intensity autocorrelation function, critical slowing down of the average relaxation time, and observation of a fractal time set in the scattered field.

43547 Structure of a-$GeSe_2$ from x-ray scattering measurements. Fuoss, P.H.; Fischer-Colbrie, A. (AT&T Bell Laboratories, Holmdel, New Jersey 07733). *Physical Review [Section] B: Condensed Matter;* **38**: No. 3, 1875-1878(15 Jul 1988).

Grazing-incidence x-ray scattering techniques have been used to study very thin (≧250 A) films of amorphous $GeSe_2$. We find that the first sharp diffraction peak in these glasses arises from intrinsic features of chemically ordered tetrahedral bonding and not necessarily from a layered nature of the glass. We find no evidence of an oriented or layered structure and conclude that, if a layered structure is present, it must differ significantly from the crystalline phase.

43548 Amorphous silicon carbide coatings for extreme ultraviolet optics. Kortright, J.B.; Windt, D.L. (University of California, Lawrence Berkeley Laboratory, Center for X-Ray Optics, Berkeley, California 94720). *Applied Optics;* **27**: No. 14, 2841-2846(15 Jul 1988).

Amorphous silicon carbide films formed by sputtering techniques are shown to have high reflectance in the extreme ultraviolet spectral region. X-ray scattering verifies that the atomic arrangements in these films are amorphous, while Auger electron spectroscopy and Rutherford backscattering spectroscopy show that the films have composition close to stoichiometric SiC, although slightly C-rich, with low impurity levels. Reflectance vs incidence angle measurements from 24 to 1216 A were used to derive optical constants of this material, which are presented here. Additionally, the measured extreme ultraviolet efficiency of a diffraction grating overcoated with sputtered amorphous silicon carbide is presented, demonstrating the feasibility of using these films as coatings for EUV optics.

43549 Optical properties of crystalline semiconductors and dielectrics. Forouhi, A.R.; Bloomer, I. (IBM Almaden Research Center, 650 Harry Road, San Jose, California 95120-6099). *Physical Review [Section] B: Condensed Matter;* **38**: No. 3, 1865-1874(15 Jul 1988).

A new formulation for the complex index of refraction, N(E) = n(E)-ik(E), as a function of photon energy E, for crystalline semiconductors and dielectrics is developed based on our previous derivation of N(E) for amorphous materials. The extinction coefficient k(E) is deduced from a one-electron model with finite lifetime for the excited electron state. The refractive index n(E) is then derived from the Kramers-Kronig relation as the Hilbert transform of k(E). It is shown that $n(\infty)>1$. Excellent agreement is found between our equations for n(E) and k(E) and published measured values for crystalline Si, Ge, GaP, GaAs, GaSb, InP, InAs, InSb, SiC, cubic C, and α-SiO_2, over a wide range of energies (~0—20 eV). Far fewer parameters, all of which have physical significance, are required and they can be determined for a particular material from the position and strength of the peaks in the k spectrum.

43550 Depletion regions and electronic surface states in doped semiconductor superlattices. Zhang, J.; Ulloa, S.E. (Department of Physics and Astronomy and Condensed Matter and Surface Sciences Program, Ohio University, Athens, Ohio 45701-2979). *Physical Review [Section] B: Condensed Matter;* **38**: No. 3, 2063-2067(15 Jul 1988).

The electronic level structure of a type-I semiconductor superlattice such as GaAs/Al/sub x/Ga/sub 1-//sub x/As has been calculated self-consistently in a tight-binding envelope approximation. Fermi-level pinning due to defects at the ends of the superlattice gives rise to novel surfacelike states lying in electronic subband gaps and having localized eigenstates. Varying barrier transparency and modulation-doping density are shown to affect the location of these surface levels within the subband gap. Application of a gate voltage across the superlattice produces drastic changes in the level structure, including transitions from extended to localized behavior in some eigenstates concurrent to shifts in their energies. Sensitivity to gate voltage should yield a unique electrooptical response function in these systems.

43551 Low-temperature specific heat of glasses: Temperature and time dependence. Jankowiak, R.; Hayes, J.M.; Small, G.J. (Ames Laboratory—U.S. Department of Energy and Department of Chemistry, Iowa State University, Ames, Iowa 50011). *Physical Review [Section] B: Condensed Matter;* **38**: No. 3, 2084-2088(15 Jul 1988).

The time and temperature dependence of the specific heat of glasses is considered in light of an analytic form for the density-of-states function of two-level systems, N(E), which has recently been calculated. It is shown that experimentally observed time and temperature dependences are explainable with this function within the same range of parameters for asymmetry and tunneling as has been used to explain other anomalous glass properties.

43552 Evolution of the dendritic instability in solidifying succinonitrile. Chou, H.; Cummins, H.Z. (Department of Physics, City College of the City University of New York, New York, New York 10031). *Physical Review Letters;* **61**: No. 2, 173-176(11 Jul 1988).

The evolution of morphological instability in solidifying succinonitrile has been investigated with high-resolution videomicroscopy. Quantitative analysis of the early development of the instability has demonstrated the critical role of noise, and indicates significant disagreement with predictions of the Mullins-Sekerka theory. The ratio of the tip radius rho/sup */ of the steady-state dendrites to the length scale λ/sub max/ of the initial instability was found to be approximately 0.5, in reasonable agreement with a recent theoretical prediction of Barbieri, Hong, and Langer.

43553 Defects and impurities at the Si/Si(100) interface studied with monoenergetic positrons. Schultz, P.J.; Tandberg, E.; Lynn, K.G.; Nielsen, B.; Jackman, T.E.; Denhoff, M.W.; Aers, G.C. (Department of Physics, The University of Western Ontario, London, Ontario, Canada N6Achemical bond3K7). *Physical Review Letters;* **61**: No. 2, 187-190(11 Jul 1988).

Positrons implanted with varying energies (0—20 keV) have been used to study silicon epilayers grown by molecular-beam epitaxy on Si(100) substrates. Defects at the initial growth interface and throughout the overlayer have been observed and depth profiled. In addition, field-driven positron drift observed in some of the epilayers is shown to be consistent with estimated concentrations of (active) interfacial impurities. The study demonstrates that positrons can be used nondestructively to profile structural defects and electric fields in thin films and at interfaces.

43554 Comment on "Adatom vibrations on Si(111) reconstructed surfaces". Li, X.; Allen, P.B.; Broughton, J.Q. (Department of Physics, State University of New York at Stony Brook, Stony Brook, New York 11794). *Physical Review Letters;* **61**: No. 2, 243-243(11 Jul 1988).

A Comment on the Letter by W. Daum, H. Ibach, and J. E. Mueller, Phys. Rev. Lett. 59, 1593 (1987).

43555 5f-band width and hybridization in uranium silicides. Sarma, D.D.; Krummacher, S.; Hillebrecht, F.U.; Koelling, D.D. (Institut fuer Festkoerperforschung, Kernforschungsanlage, D-5170 Juelich, Federal Republic of Germany). *Physical Review [Section] B: Condensed Matter;* **38**: No. 1, 1-7(1 Jul 1988).

X-ray-photoemission spectroscopy and bremsstrahlung-isochromat spectroscopy are utilized to examine the series of uranium silicides U_3Si_2, USi, USi_2, and USi_3. Maintaining the same ligand, this set of materials progresses from the case where direct f-f interaction is possible to one where only f-ligand interactions can occur. It is found that, while the results are dominated by the properties of the

measurement techniques, there is evidence for f-band broadening with increasing ligand interactions.

43556 Neutron scattering studies of the magnetic structure of cupric oxide. Yang, B.X.; Tranquada, J.M.; Shirane, G. (Brookhaven National Laboratory, Upton, New York 11973). *Physical Review [Section] B: Condensed Matter;* **38**: No. 1, 174-178(1 Jul 1988).

In light of the recent discovery of copper oxide high-T/sub c/ superconductors, we have reexamined the early neutron diffraction measurements on CuO by Brockhouse [B. N. Brockhouse, Phys. Rev. 94, A781 (1954)]. Our measurement confirmed the antiferromagnetic ordering in CuO below 225 K. The magnetic unit cell has a volume double that of the chemical unit cell. The ordered moment is 0.68μ/sub B/ per Cu, significantly smaller than 1μ/sub B/ expected for a spin-only Cu/sup 2+/ ion. The diffuse scattering was also studied well above the Neel temperature, and was found to be mostly elastic, in clear contrast to that of La_2CuO_4.

43557 Direct observation of relaxation modes in $KNbO_3$ and $BaTiO_3$ using inelastic light scattering. Sokoloff, J.P.; Chase, L.L.; Rytz, D. (Physics Department, Indiana University, Bloomington, Indiana 47401). *Physical Review [Section] B: Condensed Matter;* **38**: No. 1, 597-605(1 Jul 1988).

Cubic and tetragonal $BaTiO_3$ and orthorhombic $KNbO_3$ have been studied by Raman scattering, using an iodine filter to eliminate elastically scattered light. In addition to the usual phonon features, such as the soft E mode in tetragonal $BaTiO_3$ and the soft B_2 mode in orthorhombic $KNbO_3$, central components have been observed in both materials for the first time. These components have the linewidths, line shapes, and thermal properties of relaxation modes, and symmetry properties consistent with an eight-site order-disorder model of the successive phase transitions. Additionally, the data provide direct evidence that clusters of precursor order are present in cubic $BaTiO_3$ and the model provides estimates of the temperatures at which these clusters are present in both $BaTiO_3$ and $KNbO_3$. These values are in good agreement with the results of linear birefringence and refractive-index measurements.

43558 Effect of strain on the band structure of In/sub x/ Ga/sub 1-//sub x/As. Hwang, J.; Pianetta, P.; Kubiak, G.D.; Stulen, R.H.; Shih, C.K.; Pao, Y.; Shen, Z.; Lindberg, P.A.P.; Chow, R. (Stanford Synchrotron Radiation Laboratory, Stanford University, Stanford, California 94305). *Journal of Vacuum Science and Technology, B: Microelectronics Processing and Phenomena;* **6**: No. 4, 1234-1239(Jul 1988).

Angle-resolved photoemission spectroscopy has been used to study strained In/sub x/Ga/sub 1-//sub x/As(001) layers in pseudomorphic heterostructures grown by molecular-beam epitaxy. It is found that the Δ3+Δ4 bands and the Δ1 band respond differently to the strain perturbation. For strained GaAs(001), the Δ3+Δ4 bands (P/sub x/ +P/sub y/- like) are shifted upward in energy by a maximum amount of 0.3 eV, while in contrast, the Δ1 band (P/sub z/- like) is shifted downward by about 0.5 eV. For both strained In/sub 0.2/Ga/sub 0.8/As(001) and In/sub 0.9/Ga/sub 0.1/As(001), the band shifts are in the opposite direction to that in the GaAs case, consistent with the opposite strain conditions. The strain-induced effects due to cation (Ga or In) alloying are also discussed.

43559 Advanced unified defect model for Schottky barrier formation. Spicer, W.E.; Liliental-Weber, Z.; Weber, E.; Newman, N.; Kendelewicz, T.; Cao, R.; McCants, C.; Mahowald, P.; Miyano, K.; Lindau, I.; and others. (Stanford Electronics Labs, Stanford University, Stanford, California 94305). *Journal of Vacuum Science and Technology, B: Microelectronics Processing and Phenomena;* **6**: No. 4, 1245-1251(Jul 1988).

The advanced unified defect model (AUDM) for GaAs proposed in this paper can be looked upon as a refinement of the unified defect model (UDM) proposed in 1979 to explain Fermi level pinning on 3—5 compounds due to metals or nonmetals. The refinement lies in identifying the defect producing pinning at 0.75 and 0.5 eV above the valence band maximum as the As/sub Ga/ antisite. Since the As/sub Ga/ antisite is a double donor, a minority compensating acceptor is necessary. This is tentatively identified as the Ga/sub As/ antisite. The concentration of As excess or deficiency due to processing or reactions at interfaces is particularly emphasized in this model. A wide range of experimental data is discussed in terms of this model and found to be in agreement with it. This includes the original data on which the UDM was based as well as more recent data including Fermi level pinning on the free-GaAs(100) molecular-beam epitaxy surface, Schottky barrier height for thick (~1000 A) Ga films on GaAs, and the LaB_6 Schottky barrier height on GaAs (including thermal annealing effects). Of particular importance is the ability of this model to explain the changes in Schottky barrier height for Al and Au on GaAs due to thermal annealing and to relate these changes to interfacial chemistry.

43560 Fermi level dependent native defect formation: Consequences for metal—semiconductor and semiconductor—semiconductor interfaces. Walukiewicz, W. (Center for Advanced Materials, Lawrence Berkeley Laboratory, University of California, Berkeley, California 94720). *Journal of Vacuum Science and Technology, B: Microelectronics Processing and Phenomena;* **6**: No. 4, 1257-1262(Jul 1988).

The amphoteric native defect model of the Schottky barrier formation is used to analyze the Fermi level pinning at metal/semiconductor interfaces for submonolayer metal coverages. It is assumed that the energy required for defect generation is released in the process of surface back-relaxation. Model calculations for metal/GaAs interfaces show a weak dependence of the Fermi level pinning on the thickness of metal deposited at room temperature. This weak dependence indicates a strong dependence of the defect formation energy on the Fermi level, a unique feature of amphoteric native defects. This result is in very good agreement with experimental data. It is shown that a very distinct asymmetry in the Fermi level pinning on p- and n-type GaAs observed at liquid nitrogen temperatures can be understood in terms of much different recombination rates for amphoteric native defects in those two types of materials. Also, it is demonstrated that the Fermi level stabilization energy, a central concept of the amphoteric defect system, plays a fundamental role in other phenomena in semiconductors such as semiconductor/semiconductor heterointerface intermixing and saturation of free carrier concentration.

43561 Common-anion rule and the role of cation states: Binary versus ternary semiconductors. Kilday, D.G.; Margaritondo, G.; Ciszek, T.F.; Deb, S.K. (Department of Physics and Synchrotron Radiation Center, University of Wisconsin, Madison, Wisconsin 53706). *Journal of Vacuum Science and Technology, B: Microelectronics Processing and Phenomena;* **6**: No. 4, 1364-1368(Jul 1988).

The failure of the common-anion rule for heterojunction interfaces involving binary semiconductors has been demonstrated by many recent experiments. Wei and Zunger have explained this puzzling result in terms of a substantial role of the cation d states in determining the valence-band edge position. The same approach predicts that the valence-band edge position of certain ternary semiconductors and of their quaternary alloys depends weakly on the composition. We present synchrotron-radiation photoemission tests of these predictions.

43562 Translational symmetries in the linear-chain semiconductors $K_4[Pt_2(P_2O_5H_2)_4X]$ x nH_2O (X = Cl, Br, I). Butler, L.G.; Zietlow, M.H.; Che, C.M.; Schaefer, W.P.; Sridhar, S.; Grunthander, P.J.; Swanson, B.I.; Clark, R.J.H.; Gray, H.B. (California Institute of Technology, Pasadena (USA)). *Journal of the American Chemical Society;* **110**: No. 4, 1155-1162(17 Feb 1988).

The solid-state structures of the linear-chain semiconductors $K_4[Pt_2(P_2O_5H_2)_4X]$ x nH_2O (X = Cl, Br, I), abbreviated Pt_2Cl, Pt_2Br, and Pt_2O, have been studied. The X-ray crystal structures of Pt_2Cl at 300 and 22 K and of Pt_2Br at 19 K are reported. These structures show that Pt_2Cl is a composite of alternating units of Pt_2 and Pt_2Cl_2 with (AABCCB)/sub n/ translational symmetry. The X-ray structure of Pt_2Br, on the other hand, shows equivalent Pt-Pt bonds and two slightly different Pt-Br bonds. Raman data confirm the composite Pt_2/Pt_2Cl_2 structure for Pt_2Cl and indicate that the

Pt_3Br species is comprised of dimeric units with nearly equal Pt-Pt bonds. The Pt_3Br structure is viewed as involving a slight distortion from idealized (AAB)/sub n/ toward (AABCCB)/sub n/ translational symmetry. Structural studies of Pt_3I were attempted; however, all crystals were twinned. Magnetic susceptibility, microwave conductivity, ESCA, and reflectance spectroscopy measurements are reported for Pt_3Br; the material is a semiconductor, with $\sigma = 10^{-3}$ Omega^{-1} cm^{-1} at 300 K, a bandgap of 0.08 eV, and a bandwidth greater than 0.05 eV.

43563 (ORNL/tr—88/4) Dynamically formed membranes from polyelectrolytes in aqueous solutions. Haraya, Kenji; Nakane, Takashi; Yoshitome, Hiroshi. Translated from *Nippon Kaisui Gakkaishi ;* 32: No. 4, 197-205(1978). Contract AC05-84OR21400. 21p. NTIS, PC A03/MF A01.

The formation conditions of dynamic membranes were examined using polyethylenimine, carboxymethylcellulose, hydrous zirconium oxiside-polyacrylic acid and gelatine. In the case of reverse osmosis type membranes, except gelatine, the rejection of NaCi was found to be high when these dynamic membranes were formed in the pH range in which the viscosity of each polyelectrolyte was small. Membranes formation by adding NaCi caused increase of NaCi rejection, but this phenomenon was not observed at the minimum viscosity points of these polyelectrolytes. Furthermore the water contents of these dynamic membranes tended to decrease with increasing NaCi rejection. In another case of filtration type membrane (gelatine), self-rejection was found to be high when gelatine dynamic membrane was formed in the range of pH under pH 7. If the case of the feed solution containing NaCl at the running time, self-rejection decreased. Therefore, the repulsion between support membrane and gelatine in solution, or between gelatine dynamic membrane and gelatine in solution should be considered as an important factor in membrane performance. 11 refs., 10 figs., 3 tabs.

40 CHEMISTRY

4001 Analytical And Separations Chemistry

REFER ALSO TO CITATION(S) 42682, 42687, 42704, 43445, 43798, 43915

43564 (CONF-880435—4) Multiphoton ionization mechanisms of aromatic molecules in nonpolar fluids. Faidas, H.; Christophorou, L.G. (Oak Ridge National Lab., TN (USA); Tennessee Univ., Knoxville (USA)). 1988. Contract AC05-84OR21400. 5p. NTIS, PC A02/MF A01;1; GPO Dep. Order Number DE88008690/JAW.

From 4. international symposium on resonance ionization spectroscopy and its applications; Gaithersburg, MD, USA (10 Apr 1988).

Three distinct types of multiphoton ionization mechanisms of aromatic molecules in nonpolar liquids have been observed: (1) direct two-photon ionization; (2) stepwise three-photon ionization; and (3) mixed two- and three-photon ionization. A technique to determine the ionization threshold in the liquid phase is presented. 3 refs., 3 figs., 1 tab.

43565 (CONF-880435—21) Impurity analysis in SIMOX samples by high-efficiency resonance ionization time-of-flight mass spectrometry. Young, C.E.; Pellin, M.J.; Calaway, W.F.; Burnett, J.W.; Gruen, D.M.; Stein, H.J.; Tsao, S.S. (Argonne National Lab., IL (USA); Sandia National Labs., Albuquerque, NM (USA)). 1988. Contract W-31-109-ENG-38;AC04-76DP00789. 3p. NTIS, PC A02/MF A01; 1; GPO Dep. Order Number DE88012061/JAW.

From 4. international symposium on resonance ionization spectroscopy and its applications; Gaithersburg, MD, USA (10 Apr 1988).

The SIMOX process provides a means for the fabrication of integrated circuitry in a thin silicon layer isolated from the bulk wafer. The benefits derived from this procedure include reduced parasitic interaction of closely-spaced transistor devices and substantially increased resistance to radiation damage. These advantages can be nullified, however, by trace quantities of deep level trap impurities such as Fe in the thin silicon surface layer. The SARISA (Surface Analysis by Resonance Ionization of Sputtered Atoms) technology utilizes isochronous refocusing time-of-flight mass spectrometry optimized for the parameter useful yield: atoms detected/atoms removed from the sample. Monolayer resolution in the surface region and suppression of isobaric interferences are important instrument characteristic for the presented application.

43566 (CONF-880768—3) Evaluation of a rapid quantitative organic extraction system for determining the concentration of PCB in soils. Stewart J.H. Jr.; Bayne, C.K.; Holmes, R.L.; Rogers, W.F.; Maskarinec, M.P. (Oak Ridge National Lab., TN (USA)). 1988. Contract AC05-84OR21400. 16p. NTIS, PC A03/MF A01; 1; GPO Dep. Order Number DE88012313/JAW.

From 4. annual waste testing and quality assurance symposium; Washington, DC, USA (11 Jul 1988).

The ORNL Analytical Chemistry Division has evaluated a unique commercial organic extraction system as a possible alternative method to EPA 3540 and EPA 3550 (1), for the rapid quantitative extraction of PCB from soils and sediments. The extraction system, tradenamed SOXTEC System HT, has been evaluated to determine whether equivalent extraction efficiency to the EPA methods in SW 846 can be achieved with significant reductions in extraction time and cost per analysis. The SOXTEC extraction utilizes the SW 846 cellulose thimble and hexane-acetone extractant, and generally follows the 3540 methodology, with two significant differences. These two differences are in the initial extraction stage, when the specimen-loaded thimble is immersed directly into the hot solvent. This ensures very rapid and intimate contact between the solvent and the specimen, resulting in rapid extraction of the PCB. The thimble is then elevated above the solvent and rinse-extracted as in Method 3540. The second difference is in the final stage, when the solvent is evaporated directly from the SOXTEC collection vessels, as would occur in the K/D step of Method 3540. The extracted specimens are then ready for measurement of the PCB concentrations by the electron-capture GC Method 8080 in SW 846. The initial evaluation was to determine optimum extraction parameters, using spikes of the 1254 and 1260 Aroclors in Fuller's earth. Our hypothesis was that extraction of dried PCB from the high porosity and surface area of the clay would be far more difficult than extraction of similar PCB Aroclors coated onto soil and mineral particles. This hypothesis was corrected, and illustrative data will be presented.

43567 (CONF-8803116—1) Multiple-pulse fourier-transform EPR of free radical reactions. Bowman, M.K. (Argonne National Lab., IL (USA)). 1988. Contract W-31-109-ENG-38. 6p. NTIS, PC A 02; 3; GPO Dep. Order Number DE88011983/JAW.

From Royal Netherlands Academy of Arts and Sciences workshop on electron spin echo spectroscopy; Amsterdam, Netherlands (29 Mar 1988).

Fourier-Transform (FT) EPR spectroscopy is a natural outgrowth of Electron Spin Echo (ESE) spectroscopy. The FT-EPR spectrum collected with a single microwave pulse yields a snapshot of whatever free radicals are present in the sample during the time of the microwave pulse. Since the pulse can be as short as 2-10 ns, FT-EPR provides a convenient way of measuring the kinetics for EPR spectra of free radicals produced by laser photolysis, pulse radiolysis, etc. Although the resulting spectra have high-time and high-spectral resolution and are easily quantified, the one-pulse kinetic measurements have limitations. First, chemical reaction rates can not be measured at equilibrium. Second, the information is primarily about kinetics and not about reaction mechanisms. Third, many such systems show pronounced Chemically-Induced Dynamic Electron Polarization (CIDEP) so that the measured kinetics reflects not the chemical reaction rates; but rather, the electron spin relaxation rates. This is a particular problem for fast reactions of excited triplet states where the triplet spin-lattice relaxation rate is the major determinant of the rate of appearance of the product free radical signal.

43568 **(DOE/OR/00091—T37) Analytical laboratories method No. 3031 - the determination of carbon in uranium metal using the LECO CS-244 carbon and sulfur determinator (model 784-000).** (Westinghouse Materials Co., Fernald, OH (USA)). 12 May 1987. Contract AC05-86OR21600. 22p. NTIS, PC A 03; 3; GPO Dep. Order Number DE88012269/JAW.

A method is presented for the determination of micro amounts of carbon in uranium metal. Training under the direction of a qualified analyst and an understanding of the instrument's instruction manual are required prior to use of the CS-244.

43569 **(DOE/OR/21600—T12) Analytical laboratories method No. 4001 - automatic determination of U-235 wt% in a uranium matrix by gamma spectrometry.** (Westinghouse Materials Co., Fernald, OH (USA)). 3 Mar 1987. Contract AC05-86OR21600. 29p. NTIS, PC A03/MF A01; 1; GPO Dep. Order Number DE88012273/JAW.

This method is designed to automatically measure the U-235 concentration of various uranium-containing matrices (e.g., UO_3, UF_4, U_3O_8, sump samples, UNH, residues, etc.). Analyses are performed using a computer controlled sample changer. The technique is applicable to samples ranging from 0.20 to 20.0 wt% U-235. A complete gamma spectrometric U-235 analysis can be performed in two hours, or less.

43570 **(DOE/OR/21600—T13) Analytical laboratories method No. 4017 - the radiometric nondestructive analysis of Uranium-235 in uranium tetrafluoride.** (Westinghouse Materials Co., Fernald, OH (USA)). 27 Jan 1987. Contract AC05-86OR21600. 11p. NTIS, PC A03/MF A01; 1; GPO Dep. Order Number DE88012274/JAW.

This method permits the nondestructive measurement of U-235 in uranium tetrafluoride (UF_4) using a Ge(Li) gamma spectrometer. The method was evaluated for UF_4 in the 0.20 to 1.25 wt% U-235 concentration range, but it could be easily extended to higher U-235 concentrations by using the appropriate standard. A nondestructive U-235 measurement can be performed in about 20 minutes. No measurement interferences have been observed.

43571 **(DOE/OR/21600—T14) Analytical laboratories method No. 4015 - the radiometric determination of beta activity in recycled materials.** (Westinghouse Materials Co., Fernald, OH (USA)). 16 Jan 1987. Contract AC05-86OR21600. 12p. NTIS, PC A03/MF A01; 1; GPO Dep. Order Number DE88012276/JAW.

This method is used to compare the activity of reactor recycle uranium materials (both by-products and end-products included) to that of an aged natural uranium (ANU) standard. Both fission products and radioactive decay products are included in the measurement. Decay product activity will continue to increase for about 7 months following purification of uranium. A measurement can normally be performed in 2-4 hours. The method is applicable to a lower limit of 0.1% of the activity of ANU. No upper limit has been established.

43572 **(DOE/OR/21600—T15) Analytical laboratories method No. 4016 - the radiometric determination of gamma activity in recycled materials.** (Westinghouse Materials Co., Fernald, OH (USA)). 16 Jan 1987. Contract AC05-86OR21600. 22p. NTIS, PC A03/MF A01; 1; GPO Dep. Order Number DE88012275/JAW.

This method is used to compare the activity of reactor recycle uranium materials (both by-products and end-products included) to that of an aged natural uranium (ANU) standard. Both fission products and radioactive decay products are included in the measurement. A measurement can normally be accomplished in 2 to 4 hours. The method is applicable to a lower limit of 0.1% of the activity of ANU. No upper limit has been established.

43573 **(DOE/OR/21600—T16) Analytical laboratories method No. 4008 - the radiometric determination of total beta activity.** (Kurowski Development Co., Littleton, CO (USA)). 14 Jan 1987. Contract AC05-86OR21600. 12p. NTIS, PC A03/MF A01; 1; GPO Dep. Order Number DE88012280/JAW.

This method describes the determination of total beta activity in liquid and solid matrices. The measured activity is not indicative of any specific radionuclide, it does provide an index to the radioactive contamination of the sample. A measurement can be performed in approximately 2 hours. No measurement interferences have been observed.

43574 **(DOE/OR/21600—T17) Analytical laboratories method No. 4014 - radiometric method for the analysis of Th-232 in U metal.** (Westinghouse Materials Co., Fernald, OH (USA)). 19 Dec 1986. Contract AC05-86OR21600. 14p. NTIS, PC A03/MF A01; 1; GPO Dep. Order Number DE88012277/JAW.

Microgram quantities of thorium are extracted from a dissolved uranium metal sample (uranyl nitrate solution) with TTA (thenoyltrifluoroacetone) in xylene. Further removal of trace levels of uranium is accomplished by converting the thorium to thorium fluoride and extracting the uranium into trioctylphosphine oxide (TOPO) in cyclohexane. The thorium is reconverted to the nitrate ionic form and a planchet is then prepared and counted.

43575 **(DOE/OR/21600—T18) Analytical laboratories method No. 6002 - determination of wt% U-236 in depleted uranium hexafluoride (UF_6).** (Westinghouse Materials Co., Fernald, OH (USA)). 18 Jul 1986. Contract AC05-86OR21600. 29p. NTIS, PC A03/MF A01; 1; GPO Dep. Order Number DE88012266/JAW.

A rapid, comparison-type determination for wt% U-236 is performed on all depleted (0.20 wt% U-235) product ingots. A composite sample representing up to 30 ingots is prepared and fluorinated to UF_6 for the analysis. The U-236/(U-235 + U-235 + U-238) ratio in the UF_6 sample is compared to the same ratio in a UF_6 standard containing approximately 0.0100 wt% U-236. If the observed ratio of the sample is less than observed for the standard, the result < 0.0100 wt% U-236 is reported for all ingots in the composite sample. Eight minutes if required for one composite sample analysis.

43576 **(DOE/OR/21600—T19) Analytical laboratories method No. 1026 - graphite furnace atomic absorption method for the determination of hexavalent chromium in NPDES water samples.** (Westinghouse Materials Co., Fernald, OH (USA)). 16 Apr 1987. Contract AC05-86OR21600. 24p. NTIS, PC A03/MF A01; 1; GPO Dep. Order Number DE88012282/JAW.

This method is used for the determination of hexavalent chromium (CR^{+6}) in FMPC water effluents. The water is sampled specifically to meet US EPA National Pollutant Discharge Elimination System (NPDES) compliance requirements. Sampling locations include the Clearwell and Tank 9. The samples are not preserved by acidification. Instead, the samples are refrigerated to 4°C at the time of sampling and until analysis. The optimum concentration range is 0.005 to 0.100 mg L^{-1} Cr^{+6} with a detection limit of 0.001 mg L^{-1}. The range of the method may be extended upward by dilution. Sulfate or chloride concentrations greater than 1000 mg L^{-1}. The range of the method may be extended upward by dilution. Sulfate or chloride concentrations greater than 1000 mg L^{-1} may cause interferences. Interferences from elements forming stable chromates has not been determined. The analysis of one sample requires approximately 4 hours.

43577 **(DOE/OR/21600—T20) Analytical laboratories method No. 4002 - the radiometric determination of radium-226 and radium-228 in various matrices.** (Westinghouse Materials Co., Fernald, OH (USA)). 18 Sep 1986. Contract AC05-86OR21600. 52p. NTIS, PC A04/MF A01; 1; GPO Dep. Order Number DE88012268/JAW.

This method is applicable to the analysis of sump effluents and production by-product materials that are soluble in mineral acids. This method is used to separate, and analyze, Ra-226 and Ra-228 from solutions containing uranium, thorium, decay products, and nonradioactive materials. Typical analysis time for both Ra-226 and Ra-228 is three days. The radium isotopes can be determined to a lower detection limits of 0.010 d/m-mL.

43578 **(DOE/OR/21600—T21) Analytical laboratories method No. 1029 - graphite furnace atomic absorption method for the determination of copper in NPDES water samples.** (Westinghouse Materials Co., Fernald, OH (USA)). 17 May 1987. Contract AC05-86OR21600. 22p. NTIS, PC A03/MF A01; 1; GPO Dep. Order Number DE88012271/JAW.

This procedure is designed for use in the determination of copper (Cu) in FMPC water effluents. The water is sampled specifically to meet US EPA National Pollutant Discharge Elimination System (NPDES) compliance requirements. Sampling locations include the Clearwell and Tank 9. Trace amounts of Cu are present in the water samples along with other trace impurities, and approximately 1000 mg L^{-1} sodium and 500 mg L^{-1} calcium. The optimum concentration range is 0.005 to 0.100 mg L^{-1} with a detection limit of 0.001 mg L^{-1} Cu. The analytical range may be extended by dilution. Time required for a single analysis is 30 minutes to one hour. The following elements are reported to not interfere at the indicated concentration in mg L^{-1}: lead, cadmium, and zinc (10,000); sulfate, sodium, and potassium (9000); magnesium (4000); nitrate (2000); calcium (1000). Concurrent analysis of spiked samples is utilized to verify the absence of interference.

43579 **(DOE/OR/21600—T22) Analytical laboratories method No. 3051 - the simultaneous determination of nitrate, nitrite, and phosphate in water by an automated continuous flow analyzer.** (Westinghouse Materials Co., Fernald, OH (USA)). 7 Jun 1988. Contract AC05-86OR21600. 20p. NTIS, PC A03/MF A01; 1; GPO Dep. Order Number DE88012272/JAW.

This procedure has been devised specifically for the rapid, simultaneous, determination of nitrate, nitrite, and phosphate in biodenitrification (BND) liquors. A set of twelve samples can be completed in approximately three hours. This includes preparation of working reagent solutions, instrument set-up, and dilution of samples. Additional samples can be completed at a rate of twelve per hour.

43580 **(DOE/OR/21600—T23) Analytical laboratories method No. 4011 - radiometric determination of uranium-232 in uranium bearing materials.** (Westinghouse Materials Co., Fernald, OH (USA)). 14 Jan 1987. Contract AC05-86OR21600. 12p. NTIS, PC A03/MF A01; 1; GPO Dep. Order Number DE88012278/JAW.

The method is designed for use on recycled uranium materials and is applicable to materials that will yield at least 100 mg of uranium. Typical analysis time is 24 to 30 hours. U-232 can be measured to a lower limit of detection of 1 ppb (U-235 basis).

43581 **(DOE/OR/21600—T24) Analytical laboratories method No. 4018 - uranium isolation and purification from various matrices for subsequent uranium isotopic analysis.** (Westinghouse Materials Co., Fernald, OH (USA)). 26 Feb 1987. Contract AC05-86OR21600. 37p. NTIS, PC A03/MF A01; 1; GPO Dep. Order Number DE88012265/JAW.

This sample preparation method is designed to purify and isolate measurable quantities of uranium from varying quantities of other elements. The purified uranium is used for subsequent uranium isotope analysis. Steps are included for the purification of uranium from most commonly encountered uranium matrices. Purifications normally require 2 to 6 hours, depending on sample matrix.

43582 **(DOE/OR/21600—T25) Analytical laboratories method No. 1025 - graphite furnace atomic absorption method for the determination of total chromium in NPDES water samples.** (Westinghouse Materials Co., Fernald, OH (USA)). 14 Jan 1987. Contract AC05-86OR21600. 21p. NTIS, PC A03/MF A01; 1; GPO Dep. Order Number DE88012281/JAW.

This procedure is designed for use in the determination of total chromium (Cr) in FMPC water effluents. The water is sampled specifically to meet US EPA National Pollutant Discharge Elimination System (NPDES) compliance requirements. Sampling locations include the Clearwell and Tank 9. Trace amounts of Cr are present in the water samples along with other trace impurities, and approximately 1000 mg L^{-1} sodium and 500 mg L^{-1} calcium. The optimum concentration range is 0.005 to 0.100 mg L^{-1} with a detection limit of 0.001 mg L^{-1}Cr. The analytical range may be extended by dilution. Time required for a single analysis is 30 minutes to one hour. The following elements do not interfere at the indicated concentration in mg L^{-1}: lead, cadmium, and zinc (10,000); sulfate, sodium, and potassium (9000); magnesium (4000); nitrate (2000); calcium (1000).

43583 **(DOE/OR/21600—T26) Analytical laboratories method No. 1028 - graphite furnace atomic absorption method for the determination of nickel in NPDES water samples.** (Westinghouse Materials Co., Fernald, OH (USA)). 17 May 1987. Contract AC05-86OR21600. 22p. NTIS, PC A03/MF A01; 1; GPO Dep. Order Number DE88012284/JAW.

This procedure is designed for use in the determination of nickel (Ni) in FMPC water effluents. The water is sampled specifically to meet US EPA National Pollutant Discharge Elimination System (NPDES) compliance requirements. Sampling locations include the Clearwell and Tank 9. Trace amounts of Ni are present in the water samples along with other trace impurities, and approximately 1000 mg L^{-1} sodium and 500 mg L^{-1} calcium. The optimum concentration range is 0.005 to 0.050 mg L^{-1} with a detection limit of 0.001 mg L^{-1}Ni. The analytical range may be extended by dilution. Time required for a single analysis is 30 minutes to one hour. The following elements are reported not to interfere at the indicated concentration in mg L^{-1}: lead, cadmium, and zinc (10,000); sulfate, sodium, and potassium (9000); magnesium (4000); nitrate (2000); calcium (1000). Concurrent analysis of spiked samples is utilized to verify the absence of interference.

43584 **(DOE/OR/21600—T27) Analytical laboratories method No. 1027 - graphite furnace atomic absorption method for the determination of iron in NPDES water samples.** (Westinghouse Materials Co., Fernald, OH (USA)). 10 May 1987. Contract AC05-86OR21600. 22p. NTIS, PC A03/MF A01; 1; GPO Dep. Order Number DE88012283/JAW.

This procedure is designed for use in the determination of iron (Fe) in FMPC water effluents. The water is sampled specifically to meet US EPA National Pollutant Discharge Elimination System (NPDES) compliance requirements. Sampling locations include the Clearwell and Tank 9. Trace amounts of Fe are present in the water samples along with other trace impurities, and approximately 1000 mg L^{-1} sodium and 500 mg L^{-1} calcium. The optimum concentration range is 0.005 to 0.100 mg L^{-1} with a detection limit of 0.001 mg L^{-1} Fe. The analytical range may be extended by dilution. Time required for a single analysis is 30 minutes to one hour. The following elements are reported to not interfere at the indicated concentration in mg L^{-1}: lead, cadmium, and zinc (10,000); sulfate, sodium, and potassium (9000); magnesium (4000); nitrate (2000); calcium (1000). Concurrent analysis of spiked samples is utilized to verify the absence of interference.

43585 **(DOE/OR/21600—T28) Analytical laboratories method No. 4013 - the radiometric determination of total radioactivity.** (Westinghouse Materials Co., Fernald, OH (USA)). 14 Jan 1987. Contract AC05-86OR21600. 18p. NTIS, PC A03/MF A01; 1; GPO Dep. Order Number DE88012264/JAW.

This method presents a general approach to the measurement of alpha, beta and gamma radioactivity. Losses can occur if steps are not taken to recover volatilized activity. The measured activity is not indicative of any specific nuclide; however, it does provide an indication of the radioactive contamination level of the sample. A total activity measurement can normally be performed in 4-6 hours.

43586 **(DOE/OR/21600—T29) Analytical laboratories method No. 6005 - the determination of the uranium isotopes (wt %) by thermal ionization mass spectrometry (TMS).** (Westinghouse Materials Co., Fernald, OH (USA)). 6 Apr 1987. Contract AC05-86OR21600. 46p. NTIS, PC A03/MF A01; 1; GPO Dep. Order Number DE88012287/JAW.

Uranium isotopic analyses at all levels of isotopic concentrations can be performed on microgram quantities of uranium using this solid sample mass spectrometric technique. The uranium, extracted from the matrix material, must be purified prior to perform-

ing an analysis. An analysis is completed in approximately two hours.

43587 **(DOE/OR/21600—T30) Analytical laboratories method No. 3008 - the determination of carbon in uranium metal using the IR-212 LECO carbon analyzer model 784-400.** (Westinghouse Materials Co., Fernald, OH (USA)). 2 Oct 1986. Contract AC05-86OR21600. 21p. NTIS, PC A03/MF A01; 1; GPO Dep. Order Number DE88012270/JAW.

This method is designed for the determination of micro amounts of carbon in uranium metal. Training under the direction of a qualified analyst and an understanding of the instrument's instruction manual are required prior to use of the IR-212.

43588 **(DOE/OR/21600—T31) Analytical laboratories method No. 6003 - determination of wt% U-235 in uranium hexafluoride (UF_6) using gas mass spectrometry.** (Westinghouse Materials Co., Fernald, OH (USA)). 9 Feb 1987. Contract AC05-86OR21600. 41p. NTIS, PC A03/MF A01; 1; GPO Dep. Order Number DE88012267/JAW.

This method is applicable for determining concentrations of U-235 up to 10.0 wt%, provided appropriate standards are used. All samples must first be converted to UF_6. The approximate U-235 concentration of the sample to be analyzed must be known so the appropriate UF_6 standards can be chosen for the analysis. Twelve minutes are required for one sample analysis.

43589 **(DOE/OR/21600—T32) Analytical laboratories method No. 4010 - the radiometric determination of thorium-230 in thorium matrices.** (Westinghouse Materials Co., Fernald, OH (USA)). 14 Jan 1987. Contract AC05-86OR21600. 11p. NTIS, PC A03/MF A01; 1; GPO Dep. Order Number DE88012279/JAW.

The method is generally applicable to most thorium-bearing matrices. Amounts greater than 100 ppm of uranium and iron may cause interferences. The time required for a single analysis is 24-48 hours. The lower limit of detection for Th-230 is approximately 0.08 ppm; no maximum concentration that can be analyzed has been established.

43590 (INIS-mf—11210, pp VI18-VI19) **Epithermal neutron activation analysis for determination of trace amounts of gold in rock samples from Makhtesh Ramon.** Ne'eman, E.; Lavi, N.; Itamar, A.; Baer, G. (Tel Aviv Univ. (Israel). Research Inst. for Environmental Health; Israel Atomic Energy Commission, Yavne. Soreq Nuclear Research Center; Ministry of Energy and Infrastructure, Jerusalem (Israel). Geological Survey of Israel). Dec 1987. NTIS (US Sales Only), PC A13/MF A01. Order Number DE88780087/JAW. (CONF-871287—).

From Nuclear Societies of Israel annual meeting; Haifa, Israel (21 Dec 1987).

Transactions.; V. 14.

43591 **(JINR-R—14-87-56) Application of activation analysis to determine induced radioactivity of concretes used in nuclear set-up shielding constructions.** Lavdanskij, P.A.; Stefanov, N.I.; Nazarov, V.M.; Frontas'eva, V.M. (Moskovskij Inzhenerno-Stroitel'nyj Inst. (USSR); Joint Inst. for Nuclear Research, Dubna (USSR). Lab. of Neutron Physics). (Joint Inst. for Nuclear Research, Dubna (USSR). Lab. of Neutron Physics). 1987. 7p. (In Russian). NTIS (US Sales Only), PC A02/MF A01. Order Number DE88703779/JAW.

Submittet to the journal Sov. J. At. Energy.

Elementary content in aggregates (limestones, granites, serpentites) of shielding concretes was investigated to reveal nuclides contributing into long-lived radioactivity. These concretes are used in shielding constructions of the atomic power stations. Elementary concentration was determined by neutron activation analysis at the IBR-2 reactor of the LNP of JINR. It is shown that the nuclides mainly responsible for the long-lived radioactivity in limestones and granites are /sup 46/Sc, /sup 60/Co, /sup 134/Cs, /sup 152/Eu, /sup 154/Eu, /sup 182/Ta and that in serpentites is /sup 60/Co. The mean specific activity data for these nuclides are calculated for 6 deposits of limestones, 8 of granites and 3 of serpentinites which are presently used in the production of construction concretes for atomic power staions. 11 refs.; 1 fig.; 3 tabs.

43592 **(KFK—4368) Analytical investigations of electrofilter deposited dusts from solid waste incineration plants with special regard to the lead heavy metal.** Zink, P. (Kernforschungszentrum Karlsruhe G.m.b.H. (Germany, F.R.). Inst. fuer Radiochemie; Karlsruhe Univ. (T.H.) (Germany, F.R.). Fakultaet fuer Chemie). Feb 1988. 140p. (In German). NTIS (US Sales Only), PC A07/MF A01. Order Number DE88753782/JAW.

Three electrofilter deposited dusts from plants with and without flue gas scrubbing upstream of the electrofilter have been examined in this work for the heavy metals contained in them and their trace characterization analysis. Particular interest has been paid to the lead which is present at high concentrations of about 1 wt.-%. Phase analyses based on X-ray diffractometry have revealed that the matrix (chlorides, sulfates and quartz) inhibits the indirect characterization of the lead compounds. However, it has been proved by solubility investigations that not the lead species but rather the pH of the aqueous solution establishing in the process of leaching is determinant of the capability of lead mobilization to migrate into the liquid phase. For sanitary landfill this implies that entraining alkaline compounds into the electrofilter deposited dust by flue gas scrubbing upstream of the filter enhances lead mobilization and hence its migration into the groundwater. Lead sulfate has been identified at the surface of silicate-type residues by means of photoelectron spectroscopy. In model experiments the formation of lead sulfate has been shown to be a secondary reaction of primarily formed lead chloride with the flue gas components SO/sub 2/, O/sub 2/ and H/sub 2/O. (orig./RB)

43593 **(NUCLEBRAS-CDTN—544) Determination of carbon and sulfur in nuclear materials by direct combustion.** Monteiro, R.P.G. (Centro de Desenvolvimento da Tecnologia Nuclear, Belo Horizonte (Brazil)). 1986. 9p. (In Portuguese). NTIS (US Sales Only), PC A02/MF A01. Order Number DE88702614/JAW.

The combustion technique associated to instrumental methods for CO/sub 2/ and SO/sub 2/ to determine accurately the presence of carbon an sulfur in nuclear materials is described.

43594 **(ORNL/M—555) Analytical Chemistry Division goals and plans, 1989-1993.** Shults, W.D. (Oak Ridge National Lab., TN (USA)). 1988. Contract AC05-84OR21400. 16p. NTIS, PC A03/MF A01;1; GPO Dep. Order Number DE88012149/JAW.

This document presents goals and plans that were identified by senior staff of the Analytical Chemistry Division (ACD) at offsite meetings in mid-1987, and refined by subsequent discussion. During 1988--1990, ACD will move its mass spectrometry operations from Y-12 to X-10 where a world-class, user-friendly, collaborative research facility can be established. Vigorous reseach programs in inorganic, organic, isotopic, and actinides MS will be pursued. Laser-based analytical spectroscopy, analytical separations, specialty instrumentation, radioanalytical chemistry, neutron activation analysis, and aerosol characterization are also to be emphasized as R & D activities. ACD's core service activity will be compliance/regulatory analyses. Programs similar to the national DOE Environmental Survey will be a major source of support for analytical work of a well-defined, highly-documented nature. The ORNL ERFU program will, on the other hand, generate much work that will be new and challenging. ACD will strive to be a national leader in the analytical technology of materials (including wastes) that contain both chemical and radiochemical constituents. We will strive to maintain a wide array of analytical capabilities for support of ORNL, MMES, DOE and WFO programs. During this planning period, ACD will develop a model QA/QC program, a formalized training program in radiochemistry and radiochemical safety, industrial relations that foster technology transfer, and programs fo publicizing the division's skills and resources.

43595 **Simultaneous N_2, CO, and H_2 multiplex CARS measurements in combustion environments using a single dye laser.** Yueh, F.Y.; Beiting, E.J. (Mississippi State University, MHD Energy Center, Mississippi State, Mississippi 39762). *Applied Optics;* 27: No. 15, 3233-3243(1 Aug 1988).

A method for accurately inferring temperatures and concentrations from simultaneous multiplex CARS spectra of N_2, CO, and H_2 is introduced. Only a single dye laser is employed in these measurements. Temperatures inferred from the nitrogen portion of spectra taken in a furnace of preanalyzed samples of these gases show agreement with temperatures measured by thermocouple to well within the estimated accuracies of the thermocouple (1%). Carbon monoxide and hydrogen concentrations may be inferred from the remainder of the spectrum with accuracies of 2 and 1/2%, respectively. Spectra taken downstream from a combustor burning diesel fuel and preheated air indicated that simultaneous measurements of temperature and CO concentration with mole fractions from below 0.01 may be made in turbulent reacting flows. The S(9) rotational line of hydrogen is employed to infer concentrations of H_2. Minimum detectable mole fractions of hydrogen are presented as functions of temperature and CO mole fraction. The effects of temporal instabilities of the dye laser and interspecies coupling during analysis on the accuracy of the inferred values are discussed.

43596 **Method and apparatus for automated processing and aliquoting of whole blood samples for analysis in a centrifugal fast analyzer.** Burtis, C.A.; Johnson, W.F.; Walker, W.A. (to Dept. of Energy, Washington, DC). US Patent 4,740,472. 26 Apr 1988. Filed date 5 Aug 1985. vp. Patent and Trademark Office, Box 9, Washington, DC 20232.

A system for preparing blood samples for analysis is described comprising: a whole blood sample disc having first radial passageways arranged therein in spoked array, a serum sample disc removably secured to the whole blood sample disc and having second radial passageways arranged therein in spoked array, a sample preparation rotor having a center cavity for receiving and removably holding the whole blood and the serum sample discs, means for rotating the sample preparation rotor to separate a plurality of whole blood samples into serum and solids in the separate cavities. The cavities and the serum capillary tubes are of sufficient size such that the serum migrates by capillary action from the separate cavities into the serum sample capillaries after rotation of the apparatus is halted.

4002 Inorganic, Organic And Physical Chemistry

REFER ALSO TO CITATION(S) 42581, 42685, 42686, 42756, 43045, 43061, 43350, 43445, 43491, 44048, 44313

43597 **(DOE/ER/13306—9) Unifying framework for control system design under uncertainty and its implications for chemical process control.** Morari, M.; Doyle, J.C. (California Inst. of Tech., Pasadena (USA). Dept. of Chemical Engineering). 1986. Contract FG03-85ER13306. 24p. (CONF-8601140—1). NTIS, PC A 03; 3; GPO Dep. Order Number DE88012174/JAW.

From Conference on chemical process control III; Asilomar, CA, USA (1 Jan 1986).

Model uncertainty is one of the major problems facing control system designers in practice. In this paper a general approach is outlined for the assessment of the effects of model uncertainty on control system performance. Also discussed are methods for the design of controllers which meet given performance specifications despite model uncertainty. The power of the new techniques as well as the failure of the traditional ones is illustrated on two examples widely studied in the process control literature. The design of Smith Predictor controllers and the design of 2-point composition controllers for high purity distillation columns.

43598 **(DOE/ER/13666—2) Chemically modified electrodes and related solution studies. Technical progress report, January 15, 1987-June 1, 1988.** Elliott, C.M. (Colorado State Univ., Fort Collins (USA). Dept. of Chemistry). 1988. Contract FG02-87ER13666. 19p. NTIS, PC A03/MF A01; 1; GPO Dep. Order Number DE88012347/JAW.

During the eighteen month period covered, to date, by this grant studies have been conducted in the following areas: in an effort to better understand the catalytic oxygenation of C-H, C=C and C-C bonds by certain high valent iron porphyrin-containing enzymes and to try and exploit this chemistry (in the context of a chemically modified electrode), we have concluded an extensive study of the chemistry and properties of a stable Fe/sup III/OH prophyrin. Heteropolynuclear Fe/4Ru porphyrin complexes having unusual electrochemical and spectral properties have been prepared and initially characterized. An electrochemically polymerizable version of one of these complexes forms polymer films capable of catalyzing the electrochemical oxidation of olefins and benzylic methyl groups. Soluble polymers containing a dinuclear molybdenum sulfur complex have been developed and studied. Films cast from solutions of this polymer are insoluble in solvents such as acetonitrile, thus their electrochemical properties can be investigated. These polymers have been shown to catalyze the reduction of azobenzene. Studies have been continued with electronically conducting films made from ester-substituted bipyridine complexes of ruthenium.

43599 **Design of molecular hosts, guests, and their complexes.** Cram, D.J. (Univ. of California, Los Angeles (USA)). *Science (Washington, D.C.);* 240: 760-767(6 May 1988).

The origins, definitions, tools, and guiding principles of host-guest chemistry are developed. Perching, nesting, and capsular complexes are exemplified through molecular model and crystal structure comparisons. The degree of preorganization of a host for binding is a central determinant of its binding power. Complementarity of binding site placement in host and guest is a central determinant of structural recognition in complexation. Examples are given of chiral recognition in complexation, of partial transacylase mimics, of caviplexes, and of a synthetic molecular cell. 54 references, 6 figures.

43600 **Method of purifying neutral organophosphorus extractants.** Horwitz, E.P.; Gatrone, R.C.; Chiarizia, R. (to Dept. of Energy, Washington, DC). US Patent 4,741,857. 3 May 1988. Filed date 6 Oct 1986. vp. Patent and Trademark Office, Box 9, Washington, DC 20232.

A method of removing acidic contaminants, present in a salt or acid form, from neutral mono and/or bifunctional organophosphorous extractants is described comprising: contacting the extractant with a macroporous strong acid cation exchange resin in the H/sup +/ state to form a first mixture, maintaining the contact for a period time and at a temperature sufficient to convert the salt form of the acidic contaminant into the acid form, contacting the first mixture with a macroporous strong base anion exchange resin in the OH/sup -/ state to form a second mixture, maintaining the contact for a period of time and at a temperature sufficient for the anion resin to take up the acid form of the contaminant from the mixture, and separating the extractant from the resins containing the contaminants, thereby removing the acidic contaminants from the extractant.

43601 **Synthesis and x-ray crystal structure of an unusual oligomeric bis(pentamethylcyclopentadienyl) halide complex of cerium: [$(C_5Me_5)_2CeCl_2K(THF)$]/sub n/.** Evans, W.J.; Olofson, J.M.; Zhang, H.; Atwood, J.L. (Univ. of California, Irvine (USA)). *Organometallics;* 7: No. 3, 629-633(Mar 1988).

The reaction of $CeCl_3$ with 2 equiv of KC_5Me_5 generates the oligomeric complex [$(C_5Me_5)_2CeCl_2K(THF)$]/sub n/ which recrystallizes from THF under hexane diffusion in the space group Cc with unit-cell constants a = 11.384 (4) A, b = 28.875 (8) A, c = 8.655 (5) A, β = 100.75 (6)°, V = 2795.04 A^3, and Z = 4 with D/sub calcd/ = 1.41 g cm^{-3}. Least-squares refinement on the basis of 1867 observed reflections led to a final R value of 0.024. The complex consists of $(C_5Me_5)_2Ce(\mu\text{-}Cl)_2K(THF)$ monomer units that oligomerize via additional interunit Cl to K coordination. The oligomerization generates five-coordinate potassium ions (four Cl ligands plus one THF) and μ_3-Cl ions. Each cerium ion is surrounded by two C_5Me_5 ligands and two Cl ligands in a roughly tetrahedral arrangement with average Ce-C(ring) and Ce-Cl distances of 2.79 (2)

and 2.777 (1) A, respectively. [$(C_5Me_5)_2CeCl_2K(THF)$]/sub n/ may be sublimed at 195°C and 4 x 10^{-5} Torr to give an orange toluene insoluble material. This orange material forms $(C_5Me_5)_2CeCl(THF)$ upon extraction with THF. The latter complex crystallizes from THF in space group P anti 1 with unit-cell constants a = 8.578 (3) A, b = 17.448 (7) A, c = 18.707 (6) A, α = 62.69 (2)°, β = 89.31 (3)°, γ = 89.03 (3)°, and V = 2487.5 A^3.

43602 Reactions of heteroatom and carbon nucleophiles with the cationic bridging methylidyne complex. Casey, C.P.; Crocker, M.; Vosejpka, P.C.; Fagan, P.J.; Marder, S.R.; Gohdes, M.A. (Univ. of Wisconsin, Madison (USA)). *Organometallics;* 7: No. 3, 670-675(Mar 1988).

The reaction of the μ-methylidyne complex {[(C_5H_5)(CO)$Fe]_2(\mu$-CO)(μ-CH)}$^+$ PF_6^- (1) with NMe_3 and $(C_5H_5)_2C{=}NH$ gave the cationic 1:1 adducts {[(C_5H_5)(CO)$Fe]_2(\mu$-CO)(μ-CHNMe$_3$)}$^+$ PF_6^- (3) and {[(C_5H_5)(CO)$Fe]_2(\mu$-CHNH=C$(C_5H_5)_2$]}$^+$ PF_6^- (9), respectively, arising from attack of nitrogen on the methylidyne carbon. The reaction of 1 with KOC$(CH_3)_3$ gave the neutral μ-carbene complex [(C_5H_5)(CO)$Fe]_2(\mu$-CO)(μ-CHOC$(CH_3)P_3$] (4). Reaction of 1 with water afforded a 1:1 mixture of μmethylene complex [(C_5H_5)(CO)$Fe]_2(\mu$-CO)(μ-CH_2) (2) and [(C_5H_5)(CO)Fe]$_2(\mu$-CO)$_2$; these products are proposed to arise from disproportionation of an initially formed hydroxy carbene species. Reaction of 1 with Et_4N^+ Br^- gave the unstable $^+$-carbene complex [(C_5H_5)(CO)$Fe]_2(\mu$-CO)(μ-CHBr) (6). Reaction of 1 with the carbon nucleophiles CH_3Li and Li(C_5H_5CuCN) gave the μ-carbene complexes [(C_5H_5)(CO)$Fe]_2(\mu$-CO)(μ-$CHCH_3$) (11) and [(C_5H_5)(CO)$Fe]_2(\mu$-CO)(μ-CHC_2H_5 (12), while reaction of 1 with $HFe(CO)_4^-$ afforded 2. 1 reacted with acetone via nucleophilic addition of the enol affording the neutral μ-carbene complex [C_5H_5)-(CO)$Fe]_2(\mu$-CO)(μ-$CHCH_2COCH_3$)] (13). 1 also reacted with cyclohexanone, 2-butanone, 4-methyl-2-pentanone, 2,4-pentanedione, 5,5-dimethyl-1,3-cyclohexanedione, ethyl acetoacetate, and the sodium salt of diethyl malonate to give similar μ-carbene products.

43603 Ruthenium, rhodium, and iridium complexes of π-bound thiophene and benzo[b]thiophenes: models for thiophene binding to HDS catalysts. Huckett, S.C.; Miller, L.L.; Jacobson, R.A.; Angelici, R.J. (Iowa State Univ., Ames (USA)). *Organometallics;* 7: No. 3, 686-691(Mar 1988). Contract W-7405-ENG-82.

Ru, Rh, and Ir complexes of π-bound thiophene (T) and benzo[b]thiophenes (BTs), (eta-C_5H_5)$Ru(BT)^+$, (eta-C_5Me_5)$M(BT)^{2+}$, and (eta-C_5Me_5)$M(T)^{2+}$ (M = Rh, Ir), which serve as models for the adsorption of thiophenes on hydrodesulfurization (HDS) catalysts, have been synthesized. The Rh and IR compounds are the first dicationic transition metal complexes of either T or BTs. The BT ligands are bound to the transition metal centers via the benzene ring. The first X-ray structural characterization of a BT complex, [(eta-C_5H_5)Ru(eta^6-BT)]BF_4 (1), is reported.

43604 Manganese tricarbonyl and methylmolybdenum tricarbonyl derivatives of the as-indacene bridging ligand. Bell, W.L.; Curtis, C.J.; Miedaner, A.; Eigenbrot, C.W. Jr.; Haltiwanger, R.C.; Pierpont, C.G.; Smart, J.C. (Solar Energy Research Institute, Golden, CO (USA)). *Organometallics;* 7: No. 3, 691-695(Mar 1988).

Deprotonation of 1,6-dihydro-2,7-dimethyl-as-indacene (1) with tert-butyllithium yields the 2,7-dimethyl-as-indacene dianion (2). Reaction of 2 with molybdenum hexacarbonyl followed by methyl iodide yields (2,7-dimethyl-as-indacene)bis(methylmolybdenum tricarbonyl) (3). An X-ray structural study of 3 indicates it has a trans disposition of molybdenum groups with respect to the planar tricyclic ligand. Reaction of 2 with bis(pyridine)manganese tricarbonyl bromide at low temperature yields a mixture of cis and trans isomers of (2,7-dimethyl-as-indacene)bis(manganese tricarbonyl) that were chromatographically separated. An X-ray structural study of the cis isomer indicates considerable steric interaction between the manganese tricarbonyl groups and a bending of the as-indacene bridging ligand to accommodate this.

43605 Catalyst design. The activation of a trinuclear metal cluster complex by metal atom substitution. Adams, R.D.; Babin, J.E.; Tasi, M.; Wang, J.G. (Univ. of South Carolina, Columbia (USA)). *Organometallics;* 7: No. 3, 755-764(Mar 1988).

Investigations of the compound $Mo_2(CO)_4(C_8H_8)_2$ have shown that it will react with alkynes to give products formed by the addition and coupling of two, three, and four alkyne molecules at the dimolybdenum center. The authors have investigated the reaction of $Ru_3(CO)_9(\mu_3$-CO)(μ_3-S) with HC_2Ph under similar conditions and have found that the reaction terminates with the introduction of one HC_2Ph unit. They have now investigated the reactivity of the heteronuclear cluster $Mo_2Ru(CO)_7(C_8H_8)_2(\mu_3$-S) (1) formed by the substitution of two ruthenium carbonyl units in $Ru_3(CO)_8(\mu_3$-S) by two cyclopentadienyl molybdenum carbonyl units, with HC_2Ph, and have found that the trinuclear center in 2 is active toward HC_2Ph oligomerization. Details of this study are described in this report.

43606 Synthesis and structures of titanaoxacyclobutanes. Ho, S.C.; Hentges, S.; Grubbs, R.H. (California Institute of Technology, Pasadena (USA)). *Organometallics;* 7: No. 3, 780-782(Mar 1988). Contract FG02-86ER13545.

Titanaoxacyclobutanes can be prepared by the addition of a ketene to a titanium methylene complex or by the addition of a methylene fragment to a titanium ketene complex. For example, the addition of 2 equiv of dimethylsulfoxonium methylide to titanocene chloro-acyl complexes yields titanaoxacyclobutanes. The first equivalent deprotonates the acyl to form the titanocene ketene complex which is trapped by the second equivalent of the methylide to yield the metallaoxacyclobutane. Both routes yield complexes that are stable to temperatures above 60°C. Variable-temperature NMR studies show that the metallaoxacyclobutane ring is puckered with a barrier to inversion of 13-19 kcal/mol.

43607 Chemical and mass spectroscopic analysis of volatiles derived from clays. Heller-Kallai, L.; Miloslavski, I.; Aizenshtat, Z.; Halicz, L. (Hebrew Univ. of Jerusalem (Israel)). *American Mineralogist;* 73: No. 3-4, 376-382(Mar-Apr 1988).

Chemical analyses and mass spectra of volatiles produced by pyrolysis of clays showed that these comprised a wide variety of gaseous species. The products depend on the clay but are strongly affected by the conditions of the experiments. The temperature at which gases are formed varies. Even water collected at 250°C was acidic. Volatiles collected at 350°C contained the same species as those collected at 700°C but in different amounts and proportions. Mass spectra showed that the same gas may be released in early stages of heating from one clay and at higher temperatures from another. A clay-mineral mixture retained the gases to higher temperatures than the individual components. Replicate chemical analyses of condensed volatiles from individual clays were moderately reproducible, but entirely erratic results were obtained with a clay mixture. The effect was tentatively attributed to adsorption of the gases on clay-mineral surfaces. The chemical composition of the volatiles qualitatively accounts for their reactivity. Detailed interpretation of the information they incorporate requires much further study.

43608 Theoretical thermochemistry. 4. Ionization energies and proton affinities of AH/sub n/ species (A = Li to B and Na to Al); geometries and enthalpies of formation of their cations. Curtiss, L.A.; Pople, J.A. (Argonne National Lab., IL (USA)). *Journal of Physical Chemistry;* 92: No. 4, 894-899(25 Feb 1988). Contract W-31-109-ENG-38.

Ab initio molecular orbital theory (Moeller-Plesset theory to fourth order and a series of extended basis sets) is used to compute energies of AH/sub n/$^+$ monocations, A = Li to B and Na to Al. In combination with previously published results on the neutral species, these data are used to obtain ionization potentials, proton affinities, and enthalpies of formation. Structural predictions for these cations are also discussed.

43609 **Organic monolayers on transition-metal surfaces. The catalytically important sites.** Somorjai, G.A.; Van Hove, M.A.; Bent, B.F. (Lawrence Berkeley Lab., CA (USA)). *Journal of Physical Chemistry;* **92**: No. 4, 973-978(25 Feb 1988). Contract AC03-76SF00098.

The structure and bonding of organic monolayers have been explored by combined low-energy electron diffraction and high-resolution electron energy loss spectroscopy studies. Unusual bonding arrangements for adsorbed ethylene and benzene have been found. There is a temperature-induced sequential fragmentation of molecules that is a unique feature of the surface chemical bond. All the surface species appear very similar to multinuclear organometallic clusters revealing that the surface chemical bond is similar to that found in these clusters. The strongly bound organic surface species are not reaction intermediates during ethylene hydrogenation at 300 K but are spectators that play only secondary roles in this catalytic reaction. The coadsorption of electron acceptor molecules (CO or NO) facilitates the ordering of benzene and other organic molecules which are electron donors to the transition-metal substrates. This ordering indicates the importance of adsorbate-adsorbate interactions in forming surface structures.

43610 **Preparation, characterization and crystal structures of two amine-oxime rhodium complexes.** Lynde-Kernell, T.; Schlemper, E.O. (Univ. of Missouri, Columbia (USA)). *Journal of Coordination Chemistry;* **16**: No. 4, 347-356(1988).

Two amine-oxime complexes of rhodium(III) have been synthesized and structurally characterized as model compounds for a study of potential radiopharmaceuticals. Dichlorobis (2-acetylpyridineoxime)-rhodium(III) crystallizes in space group Pnma with a = 13.462(4), b = 12.496(2), c = 9.661(2)A, Z = 4, D/sub x/ = 1.819(2)g/cm^3. The chloro ligands are trans (av Rh-Cl = 2.337(2)A) in the octahedral Rh(III) complex. The oxime oxygens are involved in a short intramolecular hydrogen bond (O—O = 2.446(4)A) with the hydrogen atom as well as the rhodium and two chlorine atoms on the mirror. Dichloro-[4,4'-(1,2-ethanediyldiimino)bis(4-methyl-2-pentanone-dioxime)]rhodium (III) crystallizes in space group $P2_12_12_1$ with a = 14.435(3), b = 7.638(9), c = 16.596(3)A, Z = 4, D/sub x/ = 1.667(2)g/cm^3. The trans dichoro octahedral complex (av Rh downward arrow not identical to = 2.341(11)A) has cis amine nitrogens (av Rh-N = 2.079(3)A) and one cis oxime nitrogens (av Rh-N = 2.030(3)A). The oxime oxygen atoms are involved in a short intramolecular hydrogen bond (O—O = 2.423(3)A). Synthesis and proton magnetic resonance results are included, along with a comparison with other rhodium(III) amine-oxime complex structures.

4004 Electrochemistry

REFER ALSO TO CITATION(S) 43469

43611 **Proceedings of the joint international symposium on molten salts.** Mamantov, G.; Blander, M.; Hussey, C.; Mamantov, C.; Saboungi, M.L.; Wilkes, J. Pennington, NJ; The Electrochemical Society (1987). 1046p. (CONF-8710214—). The Electrochemical Society, 10 South Main St., Pennington, NJ 08534.

From International symposium on molten salts; Honolulu, HI, USA (18 Oct 1987).

The book contains papers on Molten Salts. Topics include the following: Condensed and Gaseous Products; Chemistry in the Combustion and Gasification of high Sulfur Coal; Electrical Conductivity of Binary Melts; Viscosity Measurements: molten carbonate Eutectic; and on the Technological status of Molten Carbonate.

4005 Photochemistry

REFER ALSO TO CITATION(S) 42906, 43839

43612 **Room-temperature luminescence properties of p-aminobenzoic acid and 4-phenylphenol adsorbed on α-cyclodextrin/NaCl mixtures.** Bellow, J.M.; Hurtubise, R.J. (Chemistry Department, University of Wyoming, Laramie, Wyoming 82071). *Applied Spectroscopy;* **42**: No. 4, 619-623(May 1988).

The solid-surface fluorescence and phosphorescence quantum yield values and phosphorescence lifetime values were obtained for p-aminobenzoic acid (PABA) and 4-phenylphenol adsorbed on α-cyclodexrin/NaCl mixtures. From the luminescence quantum yield and phosphorescence lifetime data, the triplet formation efficiency values, the phosphorescence rate constants, and the rate constants for radiationless transition from the triplet state were determined for PABA and 4-phenylphenol on α-cyclodexctrin/NaCl mixtures. In addition, the percentages of radiative and nonradiative transitions were calculated for the two compounds. The various luminescence parameters obtained in this work provided important insights into the analyte/α-cyclodextrin substrate interactions responsible for the observed solid-surface room-temperature fluorescence (RTF) and phosphorescence (RTP). Furthermore, the RTF and RTP intensities of PABA and 4-phenylphenol were obtained from several α-cyclodextrin/NaCl mixtures. The data showed the importance of the initial wet chemistry in the sample preparation procedure.

4006 Radiation Chemistry

43613 (KURRI-TR—295, pp 1-10) **Production of perhydroxy radical (HO/sub 2/) and oxygen in the radiolysis of aqueous solution and the LET effects.** Imamura, Masashi. (Institute of Physical and Chemical Research, Wako, Saitama (Japan)). Oct 1987. (In Japanese). NTIS (US Sales Only), PC A04/MF A01. Order Number DE88900376/JAW. (CONF-8701108—).

From Symposium on the role of oxygen in biological actions of radiation; Kyoto, Japan (23 Jan 1987).

This article aims to review the results concerning the production of perhydroxy radical (HO/sub 2/) and oxygen from irradiated aqueous solutions and the LET effects on these products, beginning with a brief introduction to the elementary primary processes in radiolysis of aqueous solution. Oxygen, if produced in the radiolysis of aqueous solution, may be considered responsible for the decreased oxygen enhancement ratio (OER) in biological systems exposed to high LET radiation. A Harwell's group has determined oxygen generated from aqueous ferrous solutions irradiated with heavy ions and concluded that the oxygen is a precursor of perhydroxy radicals. The LET-dependent yields for perhydroxy radical have been determined by LaVerne and Schuler; the analysis of their results sheds light into the reactions taking place in high-LET track cores. In conjunction with these results, the possible contributions to the LET effects are pointed out and discussed of the energetic secondary electrons ejected from the track core by knock-on collision with heavy ions and of the variation in the track core size with energy of the heavy particles.

4007 Radiochemistry And Nuclear Chemistry

REFER ALSO TO CITATION(S) 43568, 43575, 43581, 43586, 43587, 43588, 43927

43614 **(CEA-CONF—9350) Polypeptide /sup 3/H-labellings. Present methodology and new prospects.** Morgat, J.L.; Fromageot, P. (CEA Centre d'Etudes Nucleaires de Saclay, 91 - Gif-sur-Yvette (France). Dept. de Biologie). 1987. 5p. (CONF-8709304—). NTIS (US Sales Only), PC A02/MF A01. Order Number DE88754047/JAW.

From Japan symposium on peptide chemistry J.A.S.P.E.C.; Kobe, Japan (28 Sep 1987).

To understand the mechanism of action of biologically active polypeptides requires deeper insight at molecular level. Important aspects of the problem are the detection and the study of the association between the peptides and their targets. To recognise and investigate specific binding sites require highly labelled peptides. Several approaches have been used for this purpose but only a few radioisotopes possess the unrivalled property for stable peptide labelling, and among those, tritium is one of the most suitable. The purpose of the present paper is to review the different methods studied in our laboratory and also present new prospects in peptide /sup 3/H-labelling.

43615 **(CONF-880557—1) Determination of kinetics parameters using stochastic methods in a ^{252}Cf system.** Difilippo, F.C. (Oak Ridge National Lab., TN (USA)). 1988. Contract AC05-84OR21400. 13p. NTIS, PC A 03; 3; GPO Dep. Order Number DE88012203/JAW.

From NATO advanced research workshop on noise and nonlinear phenomena in nuclear systems; Valencia, Spain (23 May 1988).

Safety analysis and control system design of nuclear systems require the knowledge of neutron kinetics related parameters like effective delayed neutron fraction, neutron lifetime, time between neutron generations and subcriticality margins. Many methods, deterministic and stochastic, are being used, some since the beginning of nuclear power, to measure these important parameters. The method based on the use of the ^{252}Cf neutron source has been under intense study at the Oak Ridge National Laboratory, both experimentally and theoretically, during the last years. The increasing demand for this isotope in industrial and medical applications and new designs of advanced high flux reactors to produce it make the isotope available as neutron source (only few micrograms are necessary). A thin layer of ^{252}Cf is deposited in one of the electrodes of a fission chamber which produces pulses each time the ^{252}Cf disintegrates via α or spontaneous fission decay; the smaller pulses associated with the α decay can be easily discriminated with the important result that we known the time when v/sub c/ neutrons are injected into the system (number of neutrons per fission of ^{252}Cf). Thus, a small (few cm^3) and nonintrusive device can be used as a random pulsed neutron source with known natural properties that do no depend on biases associated with more complex interrogating devices like accelerators. This paper presents a general formalism that relates the kinetics parameters with stochastic descriptors that naturally appear because of the random nature of the production and transport of neutrons.

43616 (INIS-mf—11210, pp I12-I13) **High-temperature materials chemistry in severe fuel damage accidents in nuclear reactors.** Olander, D.R. (California Univ., Berkeley (USA). Dept. of Nuclear Engineering). Dec 1987. NTIS (US Sales Only), PC A13/MF A01. Order Number DE88780087/JAW. (CONF-871287—).

From Nuclear Societies of Israel annual meeting; Haifa, Israel (21 Dec 1987).
Transactions.; V. 14.

43617 (INIS-mf—11210, pp VII1-VII4) **Preparation of ^{75}Se by proton irradiation of Br target.** Alfassi, Z.B.; Jones-Smith, P.; Weinreich, R. (Ben-Gurion Univ. of the Negev, Beersheba (Israel). Dept. of Nuclear Engineering; Eidgenoessisches Inst. fuer Reaktorforschung, Wuerenlingen (Switzerland)). Dec 1987. NTIS (US Sales Only), PC A13/MF A01. Order Number DE88780087/JAW. (CONF-871287—).

From Nuclear Societies of Israel annual meeting; Haifa, Israel (21 Dec 1987).
Transactions.; V. 14.

43618 **(JAERI—1310) Study on the solid state chemistry of ternary uranium oxides.** Yamashita, Toshiyuki. (Japan Atomic Energy Research Inst., Tokyo). Mar 1988. 88p. NTIS (US Sales Only), PC A05/MF A01. Order Number DE88753418/JAW.

With the increase of burnup of uranium oxide fuels, various kinds of fission products are formed, and the oxygen atoms combined with the consumed heavy atoms are freed. The solid state chemical andor thermodynamic properties of these elements at high temperatures are complex, and have not been well clarified. In the present report, an approach was taken that the chemical interactions between UO_2 and these fission products can be regarded as causing overlapped effects of composing ternary uranium oxides, and formation reactions and phase behavior were studied for several ternary uranium oxides with typical fission product elements such as alkaline earth metals and rare earth elements. Precise determination methods for the composition of ternary uranium oxides were developed. The estimated accuracies for x and y values in M/sub y/U/sub 1-y/O/sub 2+x/ were +- 0.006 and +- 0.004, respectively. The thermodynamic properties and the lattice parameters of the phases in the Ca-U-O and Pr-U-O systems were discussed in relation to the composition determined by the methods. Crystal structure analyses of cadmium monouranates were made with X-ray diffraction method. (author) 197 refs.

43619 **(JINR—12-87-735) Electromigration of carrier-free radionuclides. /sup 201/Tl-thallium(1) sulfate complex in aqueous solutions.** Roesch, F.; Chan Kim Hung, M.; Milanov, M.; Khalkin, V.A. (Joint Inst. for Nuclear Research, Dubna (USSR). Lab. of Nuclear Problems). 1987. 7p. (In Russian). NTIS (US Sales Only), PC A02/MF A01. Order Number DE88703656/JAW.

Submitted to the journal Isotopenpraxis.

Stoichiometric stability constants of thallium (I) sulphate complex (Tl(SO/sub 4/))/sup -/ have been determined by measurements of /sup 201/Tl-Tl(I) ion mobility at 298.1(1) K in solutions of Na/sub 2/SO/sub 4/-Na(H)ClO/sub 4/, μ=0.1, pH ~ 4 and Na/sub 2/SO/sub 4/ 0.1 $\leqq \mu \leqq$ 0.48, pH 2-2.5. Thermodynamic stability constant of this complex anion of beta/sub 1/=15.7(1.0) lxmol/sup -1/ ha s been calculated on the basis of experimental data. 26 refs.; 2 figs.; 1 tab.

43620 **(JINR-R—6-87-182) Production of /sup 146,147,149/Gd preparations from europium irradiated with 100 MeV protons.** Lebedev, N.A.; Novgorodov, A.F.; Slovak, Ya.; Khalkin, V.A.; Ehn, L. (Joint Inst. for Nuclear Research, Dubna (USSR). Lab. of Nuclear Problems). 1987. 6p. (In Russian). NTIS (US Sales Only), PC A02/MF A01. Order Number DE88703750/JAW.

Submitted to the Organizing Comittee of 11. Radiochemical conference, Marianskie Lazni, ChSSR, Apr 1987.

To develop a production technique of highly active neutron-deficient gadolinium nuclide preparations, formation of /sup 146,147,149/Gd during irradiation of natural europium with 100 MeV protons was studied. The data on distribution of these nuclides over the target thickness were obtained. A europium oxide target of 13 g/cm/sup 2/ thick used, they were found to be produced in the following quantities: /sup 146/Gd(T/sub 1/2/=48.3 days)-8x10/sup 7/ Bq/μAxh; /sup 147/Gd(T/sub 1/2/=38.1 h)x 3.6x10/sup 9/ Bq/μAxh; /sup 149/Gd(T/sub 1/2/=9.3 days)x5.5x10/sup 7/ Bq/μAxh. Elements were separated through europium cementation by 0.3% sodium amalgam from the acetate solution with pH=4.5. Radiogadolinium is concentrated by lanthanum hydroxide precipitation and is purified of europium traces in a cation-exchange microcolumn. Separation takes $\leqq$ 3 hours, chemical yield is $\geqq$ 90%. 4 refs.; 4 figs.

4008 Combustion, Pyrolysis, And High-temperature Chemistry

REFER ALSO TO CITATION(S) 43595, 43611, 43662

43621 **(CONF-8806125—1) Cascading subcritical bifurcations of cellular flames.** Bayliss, A.; Matkowsky, B.J.; Minkoff, M. (Argonne National Lab., IL (USA)). 1988. Contract W-31109-ENG-38;FG02-87ER25027. 10p. NTIS, PC A02/MF A01;1; GPO Dep. Order Number DE88010083/JAW.

From 11. international conference on numerical methods in fluid dynamics; Williamsburg, VA, USA (27 Jun 1988).

We investigate the behavior of steady state, cellular flames. The specific problem studied is that of a flame stabilized by a line source of gaseous fuel. Thus, the source is located at the origin of a polar coordinate system in two dimensions. The investigation is carried out by numerically solving the equations of the diffusional thermal model describing such flames. The numerical method is based on a pseudo-spectral Fourier method in the angular direction. In the radial direction, we adapt the coordinate system by minimizing a newly developed functional of the solution. We find that this permits a dramatic reduction in the number of radial collocation points required. 7 refs., 3 figs.

42 ENGINEERING

4202 Facilities And Equipment

REFER ALSO TO CITATION(S) 43597, 43793

43622 (BDX—613-3931) GTAW characterization for weld penetration on 304L stainless steel: Topical report. Dereskiewicz, J.P. (Allied-Signal Aerospace Co., Kansas City, MO (USA). Kansas City Div.). May 1988. Contract AC04-76DP00613. 38p. NTIS, PC A03/MF A01;1; GPO Dep. Order Number DE88010611/JAW.

A statistical analysis determined flange thickness to be the most significant independent variable on weld penetration within the experimental range, followed by gap size and flange height. Step size was concluded to be insignificant on welf penetration in the experimental range from 0 to 0.020 in. When an optmized low heat input weld schedule was used, weld penetration was dependent upon flange thickness and flange height when gap size was less than 0.0075 in. and upon flange thickness and gap when gap size varied from 0.0075 to 0.015 in. Generally, as weld penetration increased, flange thickness and gap size decreased while flange height increased. Weld penetration could be predicted for various flange thicknesses, flange heights, and gaps by utilizing the factorial cube, surface response curves, topography maps, and weld penetration equations developed from this study. The 0.030-in. minimum weld penetration requirement could not be met throughout the tolerance range unless flange thickness was approximately 0.025 in. A technical thrust is presently being pursued to characterize a cold wire feed gas tungsten arc system to enhance weld penetration and meet product drawing requirments.

43623 (CONF-880466—8) MAGLEV: the double benefits of high-Tc superconductors and its development as an aerospace technology. Johnson, L.R.; Giese, R.F. (Argonne National Lab., IL (USA)). 1988. Contract W-31-109-ENG-38. 13p. NTIS, PC A 03; 3; GPO Dep. Order Number DE88012005/JAW.

From Conference on superconductivity and applications; Buffalo, NY, USA (18 Apr 1988).

The potential for magnetically levitated (MAGLEV) vehicles is discussed as a means of both inter-city travel and a technology option to relieve the growing problem of air traffic congestion. A brief summary is presented of the two primary maglev concepts: (1) the attractive-force, electromagnetic system (EMS) and (2) the repulsive-force, electrodynamic system (EDS), and continues with a discussion of the advantages, potential for reduced costs and higher reliability, that the newly-discovered, high-temperature superconductors offer for EDS maglev vehicles. A summary of the current status of worldwide maglev research is presented, followed by a discussion of the resurgence of US interest in maglev. An analysis of air-traffic congestion suggests that maglev can substitute for short-to-medium distance air travel. By promoting maglev as an airline technology, airlines can retain their familiar hub-and-spoke systems with maglevs an integral part of the spoke portion. A preliminary analysis suggests that maglev capital costs are likely to be comparable to those of interstate highways, and use of maglevs can declay the need for new airport and construction. For each short-to-medium flight diverted to maglev, an airline can substitute a longer flight. The short-haul flights use an inordinate amount of fuel, which is a major component of airline operating costs. Maglev energy consumption would be significantly less and would not have the emissions associated with petroleum fuel. Finally, passengers should benefit from maglev technology: travel options will be extended, delays will be reduced, and costs for inter-city travel will be reduced.

43624 (DOE/BP/92220—1) Installation performance report on pneumatic conveying consolidation. (Lane Plywood Corp., Eugene, OR (USA)). Sep 1987. Contract MS79-86BP92220. 26p. NTIS, PC A03;3. Order Number DE88008492/JAW.

The management at Lane Plywood saw an opportunity to reduce energy consumption at the mill by combining two pneumatic conveying systems into a single system. The combined connected load on the original two systems was 175 HP. The connected load on the remaining system is a single 75 HP drive. After calculating the demand on the former system and projecting the demand on the present system, a savings of 198,549 kWh/year was projected. Lane Plywood pays on average of $O.01347/kWh for electrical energy. The value of the annual savings was $2,674. The cost estimate for the project was $22,100. On a simple payback basis the project was not attractive enough when compared to other capital opportunities. However, with the incentives offered by the Bonneville Power Administration, Sponsor Design Program, the project became attractive and was accomplished. From data collected in an extensive metering effort, energy savings are amounting to 254,274 kWh/year. This is over 56,000 kWh/year more than was projected. The reason for the favorable variance is a result of the method used by pneumatic conveying suppliers in forecasting drive blower drive loads. The mill management regards the project as having accomplished its objective and considers it a success.

43625 (DOE/ER/13306—8) Newton control laws for nonlinear controller design. Economou, C.G.; Morari, M. (California Inst. of Tech., Pasadena (USA). Dept. of Chemical Engineering). 1985. Contract FG03-85ER13306. 7p. (CONF-851209—9). NTIS, PC A 02; 3; GPO Dep. Order Number DE88012173/JAW.

From 24. IEEE conference on decision and control; Ft. Lauderdale, FL, USA (11 Dec 1985).

Strong similarities between control theory and the theory on the solution of operator equations have been observed and basic results in control theory have been derived from operator theory arguments. The purpose of this work is to use the underlying duality in order to develop analysis and synthesis techniques for nonlinear systems. As an example, controllers induced by the Newton method are introduced and the corresponding stability characteristics are studied. The concepts are demonstrated by applications to linear and nonlinear systems.

43626 (DOE/ID/12619—1) Tubeless evaporation process development: Final report. (Schroeder Process Corp., Santa Ana, CA (USA)). Dec 1987. Contract AC07-86ID12619. 179p. NTIS, PC A09/MF A01; 1; GPO Dep. Order Number DE88006289/JAW.

A tubeless evaporation process which has the potential to combine the advantage of both evaporation and freezing processes, without their disadvantages is being developed. The TEP is capable of concentrating process solutions of such things as sugar, caustic soda, salt, sodium sulfate, black liquor from the pulp and paper industry, cooling tower blowdown, "spent" pickling liquor (sulfuric acid) from the steel industry, and nitric acid with potential energy savings of half to three-quarters of the energy required by conventional evaporators, with about half of the capital and maintenance cost. It has similar potential for the production of fresh water from seawater. The process uses working fluids (WF's) at their freezing point to effect direct contact heat exchange. The purpose of this project was to find additional and lower cost WF's in the laboratory, to obtain sizing information for the major equipment for an economic evaluation and a pilot plant design in a bench scale plant, and to perform the economic evaluation, and the pilot plant design and cost estimate. 6 refs., 37 figs., 7 tabs.

43627 (DOE/NE/44139—45) Remote installation of risers on underground nuclear waste storage tanks. Jackson, J.P.; Gessner, R.F. (West Valley Nuclear Services Co., Inc., West Valley, NY (USA)). Mar 1988. Contract AC07-81NE44139. 36p. NTIS, PC A03/MF A01;1; GPO Dep. Order Number DE88010531/JAW.

The West Valley Demonstration Project was established to solidify 2120 m^3 (560,000) gallons of high-level nuclear waste generated during six years of commercial nuclear fuel reprocessing. This liquid will be processed to remove radioactive elements which, with the remaining sludge, will be combined with glass formers and be converted into borosilicate glass. Risers were installed on the high-level tank for installation of pumps which will be used to remove the liquid and sludge. The extensive use of remote technology was required to install the risers and to minimize operator exposure to high levels of radiation and contamination. The riser installation required remotely: drilling through two

feet of concrete shielding; installing pump access pipes which are welded to the tank top; and cutting holes in tanks located 3658 mm (12) feet below ground. These operations were successfully completed 13 times without exposing personnel to high-level radiation or contamination. Specially designed remote equipment was developed for each step of this operation. Extensive operator training in the use of this equipment was performed on a tank with low radiation prior to work on the high-level tank. This paper discusses the application of remote technology that assured a quality job was safely accomplished. 3 refs., 18 figs., 2 tabs.

43628 **(DOE/OR/21600—T34) ASEA 60/2 industrial robot project Bardons & Oliver cut-off lathe application.** Sherman, S.J. (Westinghouse Materials Co. of Ohio, Cincinnati (USA). Feed Materials Production Center). 25 Jan 1988. Contract AC05-86OR21600. 40p. NTIS, PC A03/MF A01; 1; GPO Dep. Order Number DE88012286/JAW.

The scope of this document is to define a test plan for the testing of the ASEA 60/2 industrial robot at the Bardons and Oliver (B & O) cut-off lathe in Plant 6. This test plan describes the administrative procedures to be used and the general responsibilities of the Westinghouse Materials Company of Ohio (WMCO) organizations which are most involved in the preparation, coordination, and conduct of the installation, startup, and testing. Any deviations to this procedure will be approved by the test coordinator, Manager, Development, and Plant 6 Supervisor. The purpose of this test is to evaluate the ASEA 60/2 industrial robot to determine the feasibility of implementing a robot at the Bardons & Oliver cut-off lathe in Plant 6 for material handling purposes. This robot will be used as a developmental robot in that it will be installed temporarily at the B & O and then be relocated to another application. The robot will be used for training purposes to familiarize personnel with programming, computer usage, maintenance, and operation of the robot. Radiation exposure reduction of the machine tool operators in Plant 6 will also be determined. Success of the testing will be measured by the amount of radiation exposure reduction and determining the complexity of incorporating automated machinery with the B & O cut-off lathe utilizing a robot.

43629 **(EPRI-EM—5890) Microwave sintering of ceramics: Final report.** Johnson, D.L.; Brodwin, M.E. (Electric Power Research Inst., Palo Alto, CA (USA); Northwestern Univ., Evanston, IL (USA). Dept. of Materials Science and Engineering). Jun 1988. 41p. Research Reports Center, Box 50490, Palo Alto, CA 94303. Order Number TI88022901/JAW.

A new tunable circular cylindrical applicator for sintering ceramics is described. The principal feature is the use of thermally reflecting walls to obtain higher temperatures at the gas plasma breakdown limit. Additional useful results are improved temperature uniformity and faster heating rate. Sintering experiments were conducted on SiC, Si_3N_4, and Al_2O_3. A nitrogen atmosphere was required to suppress arcing, which retarded sintering of the SiC. Highly localized heating frustrated the attempts to sinter Si_3N_4. Alumina was sintered successfully to high density with unusually fine grain size. 6 refs., 20 figs., 4 tabs.

43630 (EPRI-NP—5490-SR, pp 18.1-18.9) **Ultrasonic evaluation of nodular cast iron.** Fleming, M.F. (Amdata, Inc., Milpitas, CA (USA)). Jun 1988. Research Reports Center, Box 50490, Palo Alto, CA 94303. Order Number TI88012214/JAW.

In Nondestructive Evaluation Program: Progress in 1987.

To ensure that containers (casks) used for transporting and storing spent nuclear fuel are safe, a program to determine their structural integrity is being conducted. Amdata, Inc. has conducted a study of the applicability of using the ultrasonic imaging technology previously developed to examine nodular cast iron (NCI), a candidate fabrication material. Test blocks of NCI selected from extreme material sample lots and measuring 12 to 15 inches in thickness were ultrasonically examined. Test targets and flaws were placed in them and the results compared with the round robin field results for thick-section inspections. The results of the tests are presented.

43631 **(JAERI-M—87-212) Effective neutron multiplication factor depending on the distance between the concrete reflector and the cylindrical fuel unit surface.** Osada, Kazuo; Naito, Yoshitaka. (Japan Atomic Energy Research Inst., Tokyo). Jan 1988. 27p. (In Japanese). NTIS (US Sales Only), PC A03/MF A01. Order Number DE88753423/JAW.

For criticality safety evaluation on a single unit of nuclear fuel, it is often assumed to immerse the nuclear fuel in water. There exists, however, the fact that the neutron multiplication factor for the nuclear fuel enclosed by the concrete walls is larger than that for fully reflected water. The collision probability of a reflected neutron by the walls with the nuclear fuel changes depending on the distance between the fuel unit and the walls. The method to express the change of the collision probability as the change of the effective neutron albedo has been developed. The neutron multiplication factor can be calculated with the effective albedo which is used as a boundary condition on the surface of a cylindrical fuel unit. The neutron multiplication factor calculated by this method showed good agreement with that calculated by the Monte Carlo code. Neutron reflection effect has been compared between the concrete walls and fully reflected water by using the effective neutron albedo. It is concluded that the neutron multiplication factor for the concrete walls is larger than that for fully reflected water, where the distance between the cylindrical fuel unit surface and the concrete walls is smaller than the radius of the cylindrical fuel unit.

43632 **(JAERI-M—88-018) General expression of manipulator kinematics.** Sasaki, Shinobu. (Japan Atomic Energy Research Inst., Tokyo). Feb 1988. 21p. (In Japanese). NTIS (US Sales Only), PC A03/MF A01. Order Number DE88753430/JAW.

In this paper, a general description for kinematic modelling of all types of manipulators is presented by expanding the concept of the homogeneous transformation (A/sub i/-matrix) based on Denavit-Hartenberg notation. Unlike the previous matrix method, the expression of recursive relationships which is suitable for computer-aided design makes it possible to derive automatically the position and orientation of manipulator hand. Two algorithms which take into consideration of the order of operation result in identical relations with respect to the kinematics between the reference system and the final link, which was proved by an application to a six-link manipulator.

43633 (LASOU—8601, pp 25-34) **Simultaneous active and reactive power control of superconducting magnet energy storage using GTO converter. Comparison between firing angle control method and pulse width modulation method.** Murakami, Yoshishige; Ise, Toshifumi; Tsuji Kiichiro. (Osaka Univ., Suita, Japan). Aug 1986. (In Japanese). Osaka University, Suita, Japan.

In Annual progress report of Laboratory for Applied Superconductivity, Osaka University.

Concerning the simultaneous active and reactive power control of superconducting magnet storage using GTO converter (2 units), two control systems were constructed and tested; one was a method of phase control, and another was a pulse width modulation control. The results are as follows. 1) Loss of GTO converter developed is less than 3.3% of the maximum power output, and efficiency is more than 92%, which means that a highly efficient self-excited type converter is constructed. 2) Both phase-control method and pulse width modulation method attained P-Q simultaneous control in the wide domain between the lagging power factor and the leading power factor. The response of P-Q simultaneous control system composed of a feed back system was approximately by the primary delay of the time constant, 30 msec, and was so quick to be applicable for the stabilization of the power system. (13 figs, 2 tabs, 5 refs)

43634 (LASOU—8601, pp 35-43) **Design and compensated characteristics of active harmonic filter for superconducting magnet energy storage.** Murakami, Yoshishige; Ise, Toshifumi; Yamada, Shin'ichi. (Osaka Univ., Suita, Japan). Aug 1986. (In Japanese). Osaka University, Suita, Japan.

In Annual progress report of Laboratory for Applied Superconductivity, Osaka University.

An active filter was designed and fabricated to compensate the harmonic current which generated from SMES which utilized a GTO power conversion unit, and a study was made on the main circuit constant and the compensation effect. The results are summarized as follows. 1) An active filter was designed and fabricated to connect a SMES (Superconducting Magnet Energy Storage) to a simulated power system having a 10 KVA generator. 2) Selection of the main circuit constant of the active filter was made to compensate a diode rectifying circuit wherein its AC side current wave form resembled that of SMES. 3) A by-pass filter consisting of L-C-R was designed to compensate the harmonics generated from the active filter. This trial was successful. 4) Compensation of harmonics of the SMES was relatively effective at the main circuit constant used. (18 figs, 3 tabs, 6 refs)

43635 (LASOU—8601, pp 44-52) **Charging and discharging control of SMES for power system stabilizer.** Murakami, Yoshishige; Mitani, Yasunori; Takechi, Yoshihiro; Tsuji, Kiichiro. (Osaka Univ., Suita, Japan). Aug 1986. (In Japanese). Osaka University, Suita, Japan.

In Annual progress report of Laboratory for Applied Superconductivity, Osaka University.

Method of electric charge and discharge was examined to properly maintain the value of magnet current of SMES (Superconducting Magnet Energy Storage) for the power system stabilization. The results are summarized as follows: 1. A few time functions were selected as a magnet current wave form at charging of SMES, and the fluctuation in the power system was obtained by simulation and experiment. It was found that the fluctuation of the power system was reduced if the magnet current was charged or discharged so as to withhold the change of the effective power output from SMES below a certain level. 2. As a method to improve the power fluctuation at the time of charge/discharge, a control system was proposed wherein a generator phase angle deviation was used as a feedback signal. 3. In cases when a delay in signal detection or a delay in magnet current control is found, a method to compensate a phase progress element which corresponds to the delay is proposed. (14 figs, 6 refs)

43636 (LASOU—8601, pp 53-63) **Design of power stabilizing control using superconducting magnet energy storage by means of singular perturbation method.** Tsuji, Kiichiro; Mitani, Yasunori; Murakami, Yoshishige. (Osaka Univ., Suita, Japan). Aug 1986. (In Japanese). Osaka University, Suita, Japan.

In Annual progress report of Laboratory for Applied Superconductivity, Osaka University.

The recent power system shows the trend that power transmission lines cover a long distance and have big capacity. In such a system, a series capacitor is very effective as one of the countermeasures to increase the power transmission capacity since it compensates the reactance of the system. However, such unstable phenomena as self-excited oscillation and subsynchronous resonance (SSR) tend to occur. Furthermore, in the long distance and large capacity power transmission system, unstable phenomena of power oscillation tend to occur at the time of quick response of the automatic voltage regulator, etc., thus forming the major cause for limiting the power transmission capacity. Accordingly, a study was made on the usage of a superconducting magnet energy storage very efficacious for stabilizing power oscillation as the device to stabilize effectively all of these kinds of unstable phenomena. The power system was subdivided into the slow-responding subsystem depicting power oscillation and the fast-responding sub-system including the modes of self-excited oscillation and SSR. The control system corresponding each of these subsystems was designed. Concerning variables which were hard to measure were estimated with the condition observation device. As the results, the effects of stabilization of power transmission and considerable increase of the power transmission capacity were obtained. (11 figs, 5 tabs, 20 refs)

43637 (LASOU—8601, pp 64-69) **Power system stabilization with superconducting magnet energy storage of simulated power transmission system.** Murakami, Yoshishige; Mitani, Yasuhiro; Murakami, Kaoru; Tsuji, Kiichiro. (Osaka Univ., Suita, Japan). Aug 1986. (In Japanese). Osaka University, Suita, Japan.

In Annual progress report of Laboratory for Applied Superconductivity, Osaka University.

Concerning superconducting magnet energy storage (SMES) as a power system stabilizer of the power system, control methods, stabilization effects and installation location had been studied. In order to verify the results of these studies, a simulated power system modeling after a long range power transmission system with large capacity was constructed and the 0.5 MJ SMES was connected to it. Using the above installation, the experiments on the system stabilization effects by the power control of SMES were performed and good results were obtained. This article reports the above experiments. Prior to the experiments with SMES using the simulated power system, a study was made through computer simulation. The results of the experiments were consistent with the knowledge obtained by the computer simulation and it was revealed that the system stabilization effect of SMES was superior to the constant voltage control only by reactive power. In addition, the location for installing SMES for the effective control of power oscillation and voltage fluctuation was successfully identified. (10 figs, 3 tabs, 2 refs)

43638 (LASOU—8601, pp 70-76) **Basic study on electrical power system stabilization using superconducting magnet energy storage.** Tsuji, Kiichiro; Mitani, Yasunori; Ise, Toshifumi; Murakami, Yoshishige. (Osaka Univ., Suita, Japan). Aug 1986. (In Japanese). Osaka University, Suita, Japan.

In Annual progress report of Laboratory for Applied Superconductivity, Osaka University.

By installing a superconducting magnet energy storage (SMES) in the power transmission system and providing it an appropriate control, its stored energy can be charged or discharged rapidly and highly efficiently. At this time, it is possible to control both active power as well as reactive power simultaneously. The application of SMES as the stabilization device for the power transmission system utilizing the above control function is now expected. This report describes a series of study results concerning the above application. The experiments of simultaneous control of both active power and reactive power was made on the SMES which had been composed by connecting a superconducting magnet to the electrical source with large capacity via gate turn off thyristor converter bridges. As the result, the control characteristics of SMES was clarified. It was confirmed that when the stabilization control of the power transmission system is done by using this simultaneous control function, the stabilization effect considerably larger than other stabilization devices can be obtained. In addition, the trade-off relationship among the various values concerning a superconducting magnet and others which are necessary for the stabilization control of the given current situations and accident conditions was revealed. (11 figs, 5 refs)

43639 (NP—8770264) **Process parameters of directly heated periodic absorption heat pump.** Grabenhenrich, H.B. (Technische Hochschule Aachen (Germany, F.R.). Fakultaet fuer Maschinenwesen). 20 Dec 1985. 97p. (In German). NTIS (US Sales Only), PC A05. Order Number DE88770264/JAW.

The study deals with the development, construction and experimental determination of the parameters of directly heated periodic absorption heat pumps. An introductory chapter is dedicated to a simple model providing the fundamental calculation parameters for instationary absorption processes. A comparative evaluation of the processes typical of the four systems possible, shows methanol/water lithium bromide to be the medium suited best for periodic systems. A discussion of the thermophysical properties, stability, corrosion behaviour and uses of above pair is followed by an experimental section which using a directly heated 10 kW test system demonstrates the measurement of systems performances showing the influence of process parameters on the quality parameters of systems. Partial load operating points are realized for a given distribution network with the help of multiple cycles including all stand-

still and stand-by losses. The operating points determined can be superimposed on the meteorological data of a given place to assess the annual efficiency of a system. The final analysis of the energy converted and energy stored in the case of real processes contributes to further systems optimizations. According to the results obtained with the help of the experimental prototype, the efficiency of the heating systems concerned can already be increased by improving the thermal insulation and utilisation of the interchangeable refrigerant mass. (BR)

43640 **(SAND—87-0673) Instrumentation for the measurement of penetrator dynamic response to permit force estimation.** Bateman, V.I. (Sandia National Labs., Albuquerque, NM (USA)). May 1988. Contract AC04-76DP00789. 34p. NTIS, PC A03/MF A01;1; GPO Dep. Order Number DE88010608/JAW.

The general problem of penetrator instrumentation is discussed, and the advantages of strain gages for the field test environment are presented. The use of strain modes shapes to determine the best locations for strain gage installation is explained and applied to a geometrically simple bar whose mode shapes can be derived analytically. For more complex structures such as penetrators, a rationale is provided to derive strain mode shapes from an acceleration-based modal analysis. This rationale is used to determine the strain mode shapes using experimental data for a penetrator body.

43641 **(SAND—87-3160) The potential use of packet radio communication by site security forces.** Cota, E.D.; Snell, M.K. (Sandia National Labs., Albuquerque, NM (USA)). Apr 1988. Contract AC04-76DP00789. 22p. NTIS, PC A03/MF A01;1; GPO Dep. Order Number DE88010604/JAW.

In this report we examine the applicability of packet radio to the communication needs of site security forces. While packet provides certain useful capabilities, we conclude that security personnel would require extensive and continuous training to be able to use packet radio communication effectively. The effort expended in such training may exceed the benefit for using the packet system. 4 figs., 1 tab.

43642 **(SAND—88-0497) Schlieren measurements at the 10,000-foot sled track.** Hill, R.A.; Hughes, R.L.; Sehmer, A.A. (Sandia National Labs., Albuquerque, NM (USA)). Jul 1988. Contract AC04-76DP00789. 19p. NTIS, PC A03/MF A01; 1; GPO Dep. Order Number DE88012748/JAW.

A schlieren technique has been used at the 10,000-foot sled track to record the interaction of the horizontal bow shock produced by a supersonic sled with the track structure. Under the conditions of these tests, the bow shock reflected from the west retaining wall is observed to interact with the aft portion of the sled; the bow shock reflected from the east rail passes to the rear of the sled. 6 refs., 10 figs.

43643 **(SAND—88-8221) Assessment of ink jet technology for micro-dispensing of metal particle-bearing fluids.** Lowe, T.C. (Sandia National Labs., Livermore, CA (USA)). May 1988. Contract AC04-76DR00789. 30p. NTIS, PC A03/MF A01;1; GPO Dep. Order Number DE88010511/JAW.

Ink jet printing technology is explored as a means for precisely depositing metal-bearing fluids on porous and nonporous substrates. Several inks were formulated and evaluated in related, but separate, ink jet experiments. Alternative ink jet hardware configurations were examined to show the influence of ink jet system parameters on droplet formation and system reliability. The experiments successfully demonstrated the feasibility of generating metal-bearing ink droplets with velocities less than 1 m/s and diameters as small as 28 micrometers. 3 refs., 6 figs., 8 tabs.

43644 **(UCID—19592-Rev.4) DYNA3D (Nonlinear Dynamic Analysis of Structures in Three Dimensions) user's manual.** Hallquist, J.O. (Lawrence Livermore National Lab., CA (USA)). Apr 1988. Contract W-7405-ENG-48. 199p. NTIS, PC A10/MF A01;1; GPO Dep. Order Number DE88012242/JAW.

This report provides an updated user's manual for DYNA3D, an explicit three-dimensional finite element code for analyzing the large deformation dynamic response of inelastic solids and structures. A contact-impact algorithm permits gaps and sliding along material interfaces with friction. By a specialization of this algorithm, such interfaces can be rigidly tied to admit variable zoning without the need of transition regions. Spatial discretization is achieved by the use of 8-node solid elements, 2-node beam elements, 4-node shell elements, 8-node solid shell elements, and rigid bodies. The equations-of-motion are integrated in time by the central difference method. DYNA3D contains twenty-eight material models and eleven equations of state to cover a wide range of material behavior. 56 refs., 46 figs.

43645 **(UCID—21358) HEAF [High Explosives Application Facility] electronics special facilities: Run/safe and access control requirements.** Emery, T.C.; O'Brien, D.W. (Lawrence Livermore National Lab., CA (USA)). Mar 1988. Contract W-7405-ENG-48. 43p. NTIS, PC A03;3. Order Number DE88008638/JAW.

This is the third in the series of documents covering detailed requirements for HEAF Electronics Special Facilities. This document, Run/Safe and Access Control Requirements, is intended to complement HEAF Electronics Special Facilities: Requirements For Computer Controls, the fourth in the series of documents. Close to 40 people have been interviewed, and discussions have been documented concerning development of the Program and engineering and safety requirements for HEAF Run/Safe and Access controls. These requirements are the result of those interviews and subsequent analysis. Requirements are reviewed by the Defense Systems Program, Engineering and Hazards Control Department before they are committed to hard engineering designs. The document is then signed off and published. These requirements represent the Program's policies and procedures for the Run/Safe and Access Control to be implemented in HEAF Designs. The implementation details are not discussed; they will be covered in follow-on design reviews. It is expected that the body of this document will, in part, establish criteria for HEAF's Facility Safety Procedure (FSP) and become the reference for later Operational Safety Procedures (OSPs). 2 refs., 4 figs.

43646 **(UCID—21359) HEAF [High Explosives Application Facility] electronics special facilities: Detailed requirements for computer controls.** Thompson, W.M. (Lawrence Livermore National Lab., CA (USA)). Mar 1988. Contract W-7405-ENG-48. 49p. NTIS, PC A03/MF A01;3. Order Number DE88008639/JAW.

This document provides system designers with detailed electronic requirements for the design of the HEAF project control system. These function and performance requirements have been carefully reviewed and agreed to by the Program. They meet the operational needs of HEAF. A description of the approach used in establishing the control system requirements is presented. Detailed user requirements and subsystem specifics follow. 2 refs., 11 figs.

43647 **(UCID—21391) Fabrication technology.** (Lawrence Livermore National Lab., CA (USA)). May 1988. Contract W-7405-ENG-48. 31p. NTIS, PC A03/MF A01;1; GPO Dep. Order Number DE88010598/JAW.

Many laboratory programs continue to need optical components of ever-increasing size and accuracy. Unfortunately, optical surfaces produced by the conventional sequence of grinding, lapping, and polishing can become prohibitively expensive. Research in the Fabrication Technology thrust area focuses on methods of fabricating components with heretofore unrealized levels of precision. In FY 87, researchers worked to determine the fundamental mechanical limits of material removal, experimented with unique material removal and deposition processes, developed servo systems for controlling the geometric position of ultraprecise machine tools, and advanced the ability to precisely measure contoured workpieces. Continued work in these areas will lead to more cost-effective processes to fabricate even higher quality optical components for advanced lasers and for visible, ultraviolet, and x-ray diagnostic systems.

43648 **(UCRL—53855) Applications of high temperature superconductors.** Holzrichter, J.F.; Struble, G.L.; McMahan, A.K.; Mapoles, E.R.; Fluss, M.J.; Kaufmann, E.N.; Winter, N.W.; Summers, L.J.; Moir, R.W.; Tuckerman, D.B.; Shay, H.D.; Darling, D.H.; Neil, G.R. (Lawrence Livermore National Lab., CA (USA)). 9 Jan 1987. Contract W-7405-ENG-48. 31p. NTIS, PC A03/MF A01;1; GPO Dep. Order Number DE88010595/JAW.

The applications of high temperature superconductors to technologies of interest to the Lawrence Livermore National Laboratory are discussed. They include high field, large bore magnets, motors and generators, magnetic fusion, inductive energy storage, rf accelerators, computers, transmission lines, and sensors. Basic principles of superconductivity and the special properties (and limitations) of high temperature superconductors that make them attractive for technology applications are described.

43649 **(SAND—87-6003) Computerized mathematical models for the analysis of physical protection systems.** Parola, H.C. Translated from Gendarmeria Nacional, Vol. 23, No. 105, July-Sept. 1986 *Gendarmeria Nacional ;* **23**: No. 105, 8-12(Jul 1986). Contract AC04-76DP00789. 15p. NTIS, PC A03/MF A01.

The subject discussed by the author, demonstrates the way in which a high-tech country uses advanced technology in direct application to physical protection. 5 figs., 2 tabs.

43650 **An apparatus for the safe handling of deuterium and tritium for muon-catalyzed fusion experiments.** Zmeskal, J.; Sherman, R.H. (Osterreichische Akademie der Wissenschaften, Institut fur Radiumforschung und Kernphysik, Boltzmanngasse 3, A-1090 Vienna (AT)). pp 28-41 of Contributions to the muon catalyzed fusion workshop. Idaho Falls, ID; Idaho National Engineering Lab. (1985). (CONF-840660—).

From Workshop on muon-catalyzed fusion reactions; Jackson, WY, USA (7 Jun 1984).

An apparatus has been constructed for the safe handling of deuterium and tritium as part of a series of studies of mesomolecular formation in the deuterium - tritium system being carried out a the Swiss Institute for Nuclear Research (SIN). The apparatus is self-contained in a portable glovebox whose monitored atmosphere was connected to the SIN effluent stack. The equipment was designed to handle 10 grams of tritium (10/sup 5/ Ci). Appropriate pumps are installed to cover the pressure range from 10/sup -7/ to 4 x 10/sup 3/ torr. The system was used successfully for continuous periods of operation of over one month. This constitutes a significant test of the non-lubricated noncontaminating vacuum and gas transfer system designed at the Tritium Systems Test Assembly for fusion power fuel systems.

4203 Lasers

43651 **(DOE/DP/40200—66) Liquid crystal optics for laser systems.** Jacobs, S.D.; Cerqua, K.A.; Marshall, K.L.; Schmid, A.; Guardalben, M.J.; Skerrett, K.J. (Rochester Univ., NY (USA). Lab. for Laser Energetics). Jan 1988. Contract FC08-85DP40200. 32p. (CONF-880110—29). NTIS, PC A03;3. Order Number DE88008475/JAW.

From SPIE O-E Lase '88: optoelectronics and laser applications in science and engineering; Los Angeles, CA, USA (10 Jan 1988).

We present an overview of the development of laser optics utilizing liquid crystals. Devices discussed include wave plates, circular polarizers, optical isolators, laser blocking notch filters and laser beam apodizers. Issues addressesed include fabrication methods and laser damage resistance.

43652 **(DOE/ER/13576—2) Nonlinear optical interactions involving the real Gaussian field. Progress report.** (Purdue Univ., Lafayette, IN (USA)). [1988]. Contract FG02-86ER13576. 3p. NTIS, PC A 02; 3; GPO Dep. Order Number DE88012399/JAW.

Development of a technique for generating a laser field known as the Real Gaussian field has been the major object of our efforts to date. This field is characterized by a randomly fluctuating amplitude, epsilon(t), whose average value is zero, E(t) = epsilon(t)e/sup -iw.t/. Application of this field to a number of nonlinear optical interactions will allow us to study the effect of laser field correlations on adsorption rates, widths, and other spectral features. The technique involves the application of a randomly fluctuating voltage to the electrodes of a pair of $LiTaO_3$ Electro-optic crystals.

43653 **Characteristics of electron-beam-excited Kr/sup */ $_2$ at low pressures as a vacuum ultraviolet source.** Eckstrom, D.J.; Nakano, H.H.; Lorents, D.C.; Rothem, T.; Betts, J.A.; Lainhart, M.E.; Triebes, K.J.; Dakin, D.A. (SRI International, Menlo Park, California 94025). *Journal of Applied Physics;* **64**: No. 4, 1691-1695(15 Aug 1988).

The performance of Kr/sup */$_2$ as a 146 nm fluorescence or laser source when pumped by a low-current, long-pulse electron beam has been determined. The fluorescence efficiency of Kr/sup */$_2$ is near the theoretical limit of ~46% at modest pressures over a range of pump rates up to 3 x 10^5 W/cm^3. Lasing could not be achieved under the conditions studied here. An improved kinetics and extraction code has been developed to model the performance of the Kr/sup */$_2$ system. A key component of the model is a more detailed treatment of the interactions between secondary electrons and excited atomic and molecular xenon states. Estimated rates for these processes are presented. With this model, good absolute agreement of model predictions with experimental results has been obtained at pressures as low as 0.5 atm.

43654 **Electron beam equilibria with self-fields for a free electron laser with a planar wiggler.** Weitzner, H.; Fruchtman, A. (Courant Institute of Mathematical Sciences, New York University, New York, New York 10012). *Physics of Fluids;* **31**: No. 8, 2340-2348(Aug 1988).

A general formalism for non-neutral cold relativistic planar steady flows is developed and applied to the study of the equilibrium of a sheet electron beam in a planar wiggler free electron laser. The full transverse dependence of the wiggler field as well as the equilibrium self-fields of the beam are included. In particular, the betatron oscillations in the presence of self-fields are studied. For a thick beam equilibrium with a particular density profile it is shown that the betatron oscillations are eliminated. For a thin beam configuration the paraxial approximation is employed and it is also shown that for some critical density there are no betatron oscillations. If the density is larger than this critical density the beam oscillates with the betatron frequency but there are no trajectory crossings and the beam preserves its cold fluid nature. The single-particle equations of motion are also considered in the presence of both planar wiggler and planar self-fields. It is shown that in some cases the particles oscillate with a reduced betatron frequency, in contrast to the previous case of cold fluid motion where the self-fields do not change the betatron frequency. For the study of the betatron oscillations in the thick beam equilibrium a two-space scale method is employed. For the thin beam within the paraxial approximation the Floquet theory for equations with periodic coefficients is used.

43655 **Ultrashort pulse propagation in KrF laser amplifiers.** Milonni, P.W.; Gibson, R.B.; Taylor, A.J. (Theoretical Division, Los Alamos National Laboratory, Los Alamos, New Mexico 87545). *Journal of the Optical Society of America B: Optical Physics;* **5**: No. 7, 1360-1368(Jul 1988).

We consider the propagation of picosecond and subpicosecond pulses in KrF amplifiers. For pulses of ≥1-psec duration, the Frantz—Nodvik model provides an excellent fit to the experimentally measured gains as well as to the predictions of a more general coherent-propagation model. For 0.1-psec pulses, however, the Frantz—Nodvik and coherent-propagation theories predict different pulse shapes, although the predicted output fluences are in excellent agreement. We discuss the question of how short an input pulse can be without incurring substantial temporal broadening as well as the effective lower-level decay rate and line shape, the saturation fluence, and the effect of nonsaturable absorbers in the amplifying medium.

43656 Comparative photon statistics of several ultraviolet laser systems determined by transient two-photon absorption. Bamford, D.J.; Hickman, A.P.; Dyer, M.J.; Bischel, W.K. (Chemical Physics Laboratory, SRI International, Menlo Park, California 94025). *Journal of the Optical Society of America B: Optical Physics;* 5: No. 7, 1369-1378(Jul 1988).

The photon statistics of several different laser systems operating at 226 nm are probed by measuring absolutely the fluorescence following two-photon absorption in atomic oxygen. The integrated fluorescence, obtained by scanning the laser frequency through the two-photon resonance, is theoretically shown to be proportional to G/sup (/²/sup)/(0)σ_0/sup (/²/sup)/. The second-order intensity-correlation function at time zero G/sup (/²/sup)/(0), characterizes the laser, and σ_0/sup (/²/sup)/ is a fundamental atomic property. Measurement of the integrated fluorescence permits determination of the relative value of G/sup (/²/sup)/(0) for each laser. The assumption that G/sup (/²/sup)/(0) = 1 for one of the lasers, a single-frequency source, allows G/sup (/²/sup)/(0) for the other lasers to be placed on an absolute scale. The values thereby obtained range from 0.8 +- 0.2 to 3.2 +- 0.4. Different values are obtained when the radiation is generated by frequency mixing or Raman shifting of the same frequency-doubled visible dye laser, suggesting that frequency-conversion processes have a significant effect on G/sup (/²/sup)/(0).

43657 Optimization of two-photon-resonant four-wave mixing: application to 130.2-nm generation in mercury vapor. Smith, A.V.; Alford, W.J.; Hadley, G.R. (Sandia National Laboratories, Albuquerque, New Mexico 87185). *Journal of the Optical Society of America B: Optical Physics;* 5: No. 7, 1503-1519(Jul 1988).

A detailed model of two-photon-resonant four-wave mixing that includes the consideration of efficiency-limiting processes is presented. The model provides a generally applicable systematic approach for maximizing conversion efficiencies for both exact and near two-photon resonance. For exact two-photon resonance, an interference effect limits efficiency to a value determined by ratios of nonlinear susceptibilities and input intensities. For near two-photon resonance, nonlinear refractive indices limit efficiencies unless input intensities are properly balanced. For the specific case of 130.2-nm generation in Hg, we examine a number of potential additional efficiency-limiting processes, including amplified spontaneous emission, stimulated Raman and hyper-Raman gain, parametric gain, linear absorption, and population transfer. We include isotopic effects and Gaussian-profile beams. From our analysis, we conclude that efficiencies of approximately 10% should be feasible by using collimated light beams in an energy-scalable system.

43658 Quantum theory of amplified spontaneous emission: scaling properties. Garrison, J.C.; Nathel, H.; Chiao, R.Y. (Lawrence Livermore National Laboratory, University of California, Livermore, California 94550). *Journal of the Optical Society of America B: Optical Physics;* 5: No. 7, 1528-1539(Jul 1988).

We formulate a second-quantized theory of propagation in laser-active media and apply it to the description of amplified spontaneous emission for the case of homogeneously broadened three-level atoms in a rodlike geometry with arbitrary Fresnel number. The electromagnetic field is treated in paraxial approximation by an ad hoc quantization scheme, and spontaneous emission into off-axis modes is described by noise operator methods. We show by a scaling (dimensional) analysis how to derive the characteristic fields and lengths for superfluorescence and amplified spontaneous emission. The results show that dye media can be used as experimental analogs for x-ray lasers.

43659 Observation of stochastic resonance in a ring laser. McNamara, B.; Wiesenfeld, K.; Roy, R. (School of Physics, Georgia Institute of Technology, Atlanta, Georgia 30332). *Physical Review Letters;* 60: No. 25, 2626-2629(20 Jun 1988).

We report the first observation of stochastic resonance in an optical device, the bidirectional ring laser. The experiment exploits a new technique to modulate periodically the asymmetry between the two counter-rotating lasing modes. The measurements verify that the addition of injected noise can lead to an improved signal-to-noise ratio (relative to that observed with no externally injected noise).

43660 Laser photography pulse synchronization circuit. Auds, J.M.; Becker, R.J. (to Secretary of the Air Force, Washington, DC). US Patent 4,745,608. 17 May 1988. Filed date 27 Jun 1986. vp. Patent and Trademark Office, Box 9, Washington, DC 20232.

A laser keep alive triggering control apparatus for initiating the generation of laser output pulses, maintaining laser operation temperatures, and slaving the occurrence of laser output pulses to a variable speed mechanical apparatus is described comprising: a pulse triggered laser; first pulse sourcing means including a free-running electronic oscillator circuit received therein, second pulse sourcing means including a signal pickup transducer responsive to predetermined movement events of the variable speed mechanical apparatus for generating second electrical pulses also capable of triggering bursts of optical energy from the laser; electronic switching means responsive to a predetermined rate of the second pulse sourcing means for selecting one or the other of the first sourcing means and second sourcing means electrical pulses of the laser; and means for inhibiting premature first and second pulses and resultant short cycle triggering of the laser, following first pulse to second pulse and second pulse to first pulse triggering changes in the switching means.

4204 Heat Transfer And Fluid Flow

REFER ALSO TO CITATION(S) 43192

43661 (ANL—88-15) Measurements of pressure drop and heat transfer in turbulent pipe flows of particulate slurries. Liu, K.V.; Choi, U.S.; Kasza, K.E. (Argonne National Lab., IL (USA)). May 1988. Contract W-31109-ENG-38. 102p. NTIS, PC A06/MF A01; 1; GPO Dep. Order Number DE88013622/JAW.

Argonne National Laboratory (ANL), under sponsorhip of the US Department of Energy, Office of Buildings and Community Systems, has been conducting a comprehensive, long-range program to develop high- performance advanced energy transmission fluids for use in district heating and cooling (DHC) systems. The current study focuses on the development of phase-change slurries as advanced energy transmission fluids. The objectives are (1) to establish proof-of-concept of enhanced heat transfer by a slurry, with and without phase change, relative to heat transfer in a pure carrier liquid; (2) to investigate the effect of particle volumetric loading, size, and flow rate on the slurry pressure drip and heat transfer behavior with and without friction-reducing additives; and (3) to generate pressure drop and heat transfer data needed for the development and design of improved DHC systems. Two types of phase-change materials were used in the experiments: ice slush for cooling, and cross-linked, high- density polyethylene (X-HDPE) particles with diameters of 1/8 and 1/20 in. (3.2 and 1.3 mm) for heating. The friction-reducing additive used in the tests was Separan AP-272 at 65 wppm. This report describes the test facility, discusses the experimental procedures, and presents significant experimental results on flow and heat transfer characteristics of the non-melting slurry flows. 51 refs., 36 figs., 6 tabs.

43662 (CONF-880724—21) Heat release effects of reacting gas jets in liquids. Cho, D.H.; Armstrong, D.R.; Bova, L. (Argonne National Lab., IL (USA)). 1988. Contract W-31-109-ENG-38. 9p. NTIS, PC A 02; 3; GPO Dep. Order Number DE88011971/JAW.

From 25. American Society of Mechanical Engineers/American Institute of Chemical Engineers/American Nuclear Society national heat transfer conference; Houston, TX, USA (24 Jul 1988).

An experimental study of a hydrogen chloride gas jet reacting in an aqueous solution of ammonia was conducted. The profile of the gaseous jet penetration (plume) exhibited a periodic or cyclic change, involving spherical growth, axial expansion, and necking often accompanied by detachment and collapse. Similar periodic fluctuations were observed in the bath pressure measurements. It is believed that the observed plume mostly consists of ammonia vapor produced due to reaction heat release and that the periodic behavior is caused by the growth and collapse of the ammonia vapor. It was possible to correlate a large amount of plume length data based on the notion that the plume length is determined by the distance

required for condensation of the ammonia vapor. The characteristics of pressure fluctuations depended strongly on the bath subcooling, resembling those for vapor jets condensing in liquids.

43663 **(EPRI-NP—5570-Vol.2) Flow velocity and turbulence measurements in a Westinghouse D-4 steam generator model: Volume 2, Test data: Final report.** Witt, E.A. Jr.; Marhefka, B.F.; Delose, F. (Electric Power Research Inst., Palo Alto, CA (USA); Westinghouse Electric Corp., Pittsburgh, PA (USA). Water Reactor Divisions). Jun 1988. 398p. Unlimited audience, publicly available. Research Reports Center, Box 50490, Palo Alto, CA 94303;1. Order Number TI88012215/JAW.

Turbulence and velocity measurements were made in a 2/3-scale model of a D4 steam generator inlet waterbox. The instrumentation used for the measurements was a hot-film constant-temperature anemometer using X-oriented cylindrical sensors. The objective of the test was to determine turbulence levels and characteristics within the waterbox volume for the purpose of evaluation and use in the {open«-quotes}GUST{close«-quotes} computer code which predicts these parameters. The test was performed over a period of six months with difficulties arising in using the sensors for this application. The results of the test showed that while mean velocity measurements were difficult to directionalize, the magnitudes were consistent with prior velocity measurements made with pitot/static-type probes. In addition, turbulence intensity measurements indicated that as suspected, the waterbox flow is highly turbulent and that the turbulence level increases with proximity to the tube bank. A number of processed data functions were also generated. The Power Spectral Density (PSD) plots showed that the majority of the energy is contained in the low-frequency range (less than 100 Hz). It also appears that this energy is confined to pockets within the center portion of the model. Micro and Macro time scales from the Autocorrelation Functions (ACF) of the data confirm that the largest eddies correspond to areas of highest energy; namely the center of the model. Micro and Macro spatial scales in areas near the walls and tubes are very close, indicating lower energies. Only the raw and reduced data are covered in this volume.

43664 **(IC—88/41) Free convection heat and mass transfer to steady flow in a semi-infinite vertical porous medium.** Bestman, A.R. (International Centre for Theoretical Physics, Trieste (Italy)). Feb 1988. 11p. NTIS (US Sales Only), PC A03/MF A01. Order Number DE88703529/JAW.

Analytical solutions are derived for a flow in a semi-infinite vertical porous medium with heat and mass transfer. When the temperature and mass concentration are uniform a constant pressure is possible and sustains a fully developed flow. Thereafter there is a small perturbation on the wall temperature and concentration and the subsequent two-dimensional problem is tackled for a large Prandtl number, free convection parameters and small Reynolds number. The heat transfer rate at the wall is discussed quantitatively. (author). 4 refs.

43665 **(IC—88/74) Unsteady flow of an incompressible fluid in a horizontal porous medium with suction.** Bestman, A.R. (International Centre for Theoretical Physics, Trieste (Italy)). Apr 1988. 9p. NTIS (US Sales Only), PC A02/MF A01. Order Number DE88703537/JAW.

A theoretical analysis of two-dimensional unsteady flow in a porous medium bounded by a horizontal wall is presented as a perturbation on a basic flow. It is assumed that the perturbation is occasioned by a sudden suction at the wall. Even for a highly permeable medium the characteristic Reynolds number in porous media flow is usually small and asymptotic solutions are developed by the Laplace transform technique. It is observed that the perturbed shear stress at the wall decays exponentially with time. (author). 5 refs.

43666 (INIS-mf—11210, pp I9-I11) **Non-intuitive thermal-hydraulics in reactor safety and containment technology.** Moody, F.J. (General Electric Co., San Jose, CA (USA). Nuclear Energy Div.). Dec 1987. NTIS (US Sales Only), PC A13/MF A01. Order Number DE88780087/JAW. (CONF-871287—).

From Nuclear Societies of Israel annual meeting; Haifa, Israel (21 Dec 1987).
Transactions.; V. 14.

43667 (INIS-mf—11210, pp III9-III13) **Homogeneous non equilibrium critical flow model.** Dickman, S.; Kaizerman, S.; Elias, E. (Technion-Israel Inst. of Tech., Haifa. Dept. of Nuclear Engineering). Dec 1987. NTIS (US Sales Only), PC A13/MF A01. Order Number DE88780087/JAW. (CONF-871287—).

From Nuclear Societies of Israel annual meeting; Haifa, Israel (21 Dec 1987).
Transactions.; V. 14.

43668 (INIS-mf—11210, pp III14-III18) **Critical two-phase flow.** Dagan, R.; Wacholder, E.; Elias, E. (Technion-Israel Inst. of Tech., Haifa. Dept. of Nuclear Engineering). Dec 1987. NTIS (US Sales Only), PC A13/MF A01. Order Number DE88780087/JAW. (CONF-871287—).

From Nuclear Societies of Israel annual meeting; Haifa, Israel (21 Dec 1987).
Transactions.; V. 14.

43669 (INIS-mf—11210, pp III19-III22) **Experimental apparatus for quantitative measurements in the precursory cooling regime during bottom reflooding.** Barnea, Y.; Elias, E.; Shai, I. (Technion-Israel Inst. of Tech., Haifa. Dept. of Nuclear Engineering; Ben-Gurion Univ. of the Negev, Beersheba (Israel). Dept. of Mechanical Engineering). Dec 1987. NTIS (US Sales Only), PC A13/MF A01. Order Number DE88780087/JAW. (CONF-871287—).

From Nuclear Societies of Israel annual meeting; Haifa, Israel (21 Dec 1987).
Transactions.; V. 14.

43670 (INIS-mf—11210, pp III23-III27) **Effect of precursory cooling on rewetting of a solid cylinder.** Olek, S. (Eidgenoessisches Inst. fuer Reaktorforschung, Wuerenlingen (Switzerland)). Dec 1987. NTIS (US Sales Only), PC A13/MF A01. Order Number DE88780087/JAW. (CONF-871287—).

From Nuclear Societies of Israel annual meeting; Haifa, Israel (21 Dec 1987).
Transactions.; V. 14.

43671 **A nonlinear wave equation in nonadiabatic flame propagation.** Booty, M.R.; Matalon, M.; Matkowsky, B.J. (Dept. of Engineering Sciences and Applied Mathematics, Northwestern Univ., Evanston, IL (US)). *SIAM Journal on Applied Mathematics;* **48**: No. 3, 519-536(Jun 1988).

The authors derive a nonlinear wave equation from the diffusional thermal model of gaseous combustion to describe the evolution of a flame front. The equation arises as a long wave theory, for values of the volumeric heat loss in a neighborhood of the extinction point (beyond which planar uniformly propagating flames cease to exist), and for Lewis numbers near the critical value beyond which uniformly propagating planar flames lose stability via a degenerate Hopf bifurcation. Analysis of the equation suggests the possibility of a singularity developing in finite time.

4205 Materials Testing

REFER ALSO TO CITATION(S) 42729, 42895, 43040, 43041, 43042, 43044, 43130, 43131, 43132, 43133, 43134, 43135, 43136, 43137, 43138, 43139, 43140, 43141, 43142, 43143, 43144, 43145, 43146, 43147, 43148, 43149, 43150, 43151, 43152, 43153, 43154, 43155, 43156, 43157, 43158, 43159, 43160, 43161, 43532, 43630

43672 **(AD-A—191965/3/XAB) Navy vehicles: acoustic emission related to nondestructive testing. Final report, 1980-1987.** Ono, K. (California Univ., Los Angeles (USA). Dept. of Materials Science and Engineering). 12 Apr 1988. 16p. NTIS, PC A03/MF A01.

This investigation was aimed at studying acoustic emission for applications to residual stress measurements and for the evaluation of structural integrity of engineering structures. Effects of microstructure, composition and prior cold working on magnetome-

chanical acoustic emission(MAE) have been studied. Magnetization behavior, magnetostriction and Barkhausen noise are affected by stress as well as other parameters. These responses have been measured simultaneously in order to identify the stress level uniquely. Combinations of advanced signal analysis methods and MAE measurements have been studied to identify the optimum parameters for applications. This work has established mechanisms of MAE signal generation, effects of various parameters that influence the MAE behavior of materials and signal processing techniques that allow materials characterization via MAE. Included are neutron-irradiated reactor-vessel steels, large-size steel plates as well as single crystals of various ferromagnetic metals and alloys. In the second part of this study, acoustic emission from materials undergoing plastic deformation and fracture were examined in an attempt to improve detection capability of the impending structural failure. Acoustic emission characteristics of reactor-vessel steels, advanced aluminum alloys and metal and ceramic-matrix composite materials have been evaluated in detail.

43673 **(DOE/OR/21600—T33) Failure analysis of the crane failure at the UF_6 - UF_4 expansion facility.** Henry, E.; Hubschman, L. Jr.; Merhley, R.; Milazzo, R. (Westinghouse Materials Co., Fernald, OH (USA)). 15 Dec 1987. Contract AC05-86OR21600. 27p. NTIS, PC A03/MF A01; 1; GPO Dep. Order Number DE88012285/JAW.

Cracking of the double strand chain, P/N T-3829, resulted from stress corrosion cracking. The cracks originated from areas of intergranular corrosion located in the center of the pins along the areas where the links are attached. The corrosion present is due to the many corrosive environments the crane has been exposed to over the years. The corrosion is most aggressive in the center of the pin due to entrapment as a result of the links. Pins 2 through 6 failed in shear-face tensile overload as a result of stress corrosion cracking initiating circumferentially around the pin in the region midway through the length of the pin. Pin 1 failed in flat-face tensile overload due to stress corrosion cracking in the same region as pins 2 through 6. Therefore, it is believed that pin 1 was the last to fail. The outer 5 pins were so smeared, that a definite origin could not be determined. However, it is also believed that possibly the missing portion of pin 4 could have failed first, separated the double strand chain inducing a high degree of tensile loading on the rest of the chain, particularly in the area of the chain surrounding pin 4. This tensile loading, along with the high amounts of corrosion present, initiated stress corrosion cracking sites on the various pins, ultimately causing catastrophic failure in tensile overload.

43674 **(INIS-mf—11210, pp VI25-VI30) Ultrasound inspection of the adhesive properties of metal to metal bondings.** Dickstein, P.; Segal, Y. (Technion-Israel Inst. of Tech., Haifa. Dept. of Nuclear Engineering). Dec 1987. NTIS (US Sales Only), PC A13/MF A01. Order Number DE88780087/JAW. (CONF-871287—).

From Nuclear Societies of Israel annual meeting; Haifa, Israel (21 Dec 1987).

Transactions.; V. 14.

4208 Electronic Circuits And Devices

REFER ALSO TO CITATION(S) 43045, 43395, 43810, 43814, 44305

43675 **(DOE/ER/45048—1) Intrinsic and extrinsic energy states of semiconductors and heterostructures using novel techniques: Final report for the period of December 1, 1986-March 30, 1988.** Chandrasekhar, H.R. (Missouri Univ., Columbia (USA). Dept. of Physics and Astronomy). Apr 1988. Contract AC02-84ER45048. 19p. NTIS, PC A03/MF A01;1; GPO Dep. Order Number DE88008560/JAW.

We have succeeded in performing the first study of all the quantized levels in a GaAs–Ga/sub 1-x/Al/sub x/As multiple quantum well (MQW) structure using a combination of three novel experimental techniques: (a) photoreflectance spectroscopy which is sensitive to very small changes in optical constants due to its derivative nature, (b) application of large hydrostatic pressures using a diamond anvil cell. The conduction band extrema at different points in the momentum space of a semiconductor can be drastically altered by the application of large pressures. This enables one to study the states associated with high energy bands, (c) the ability to perform (a) and (b) as a function of temperature has enabled us to identify features which are highly sensitive to temperatures. The new and interesting results that have emerged are: (a) accurate temperature and pressure coefficients of a large number of MQW levels, (b) quantitative information of the carrier confinement and its dependence on various band structure parameters, (c) the pressure coefficients associated with the higher bands along the L and X. We have also simultaneously performed the photoluminescence studies under pressure at cryogenic temperatures. The important implications of these results in understanding the nature of deep levels in bulk semiconductors and heterostructures is discussed. 6 figs.

43676 **(SAND—87-0851) Description and operating instructions: TEMPO high-voltage microwave driver, Walter Reed Army Institute of Research.** Rohwein, G.J. (Sandia National Labs., Albuquerque, NM (USA)). Jun 1988. Contract AC04-76DP00789. 20p. NTIS, PC A03/MF A01;1; GPO Dep. Order Number DE88012109/JAW.

This manual describes the TEMPO high-voltage (HV) microwave driver and provides operating procedures and general maintenance requirements. It is intended as a guide for experienced personnel familiar with operating HV pulsed power equipment and not as a detailed instruction for inexperienced operators. For safety reasons, inexperienced personnel should never attempt to charge and fire HV pulsed power equipment. Serious personnel injury and damage to the machine can result from improper operation. 13 figs., 1 tab.

43677 **(SAND—87-2521C) Computer controlled data acquisition system for the NASA 1986 Rocket Triggered Lightning Program.** Johnson, J.P.; Arellano, J.M.; Hasbrouck, R.T.; Lamb, J.W. (Sandia National Labs., Albuquerque, NM (USA); Lawrence Livermore National Lab., CA (USA)). 1988. Contract AC04-76DP00789. 27p. (CONF-880493—1). NTIS, PC A03/MF A01;1; GPO Dep. Order Number DE88008335/JAW.

From International conference on lightning and static electricity; Oklahoma City, OK, USA (19 Apr 1988).

The lightning-strike object (LSO) for the NASA 1986 Rocket Triggered Lightning Program (RTLP-86) was provided jointly by Sandia National Laboratories and Lawrence Livermore National Laboratory. The LSO was a large Faraday-cage-like metal canister containing electronic equipment with an electrical cable extending to a lightning rod 7 m above the canister. The lightning attachment was to the cable outer shield, which was shorted to the inner conductor(s) at the top end of the cable. Transient limiters were employed on each conductor entering the canister. Measurements were made both inside and outside. Computer controlled digital oscilloscopes were chosen to handle the large amount of data and for a fast system response. Eight dual-channel oscilloscopes, a computer, printer, and plotter recorded lightning stroke current applied to the LSO and various voltage and current responses inside. Computer software was written specifically for the RTLP-86 to collect and store data from the oscilloscopes. Turn-around time for the instrumentation system was two to three minutes. Isolation from lightning-induced currents and EMI was maintained through the use of nine fiber-optic data links between the sensors and the recording equipment which was housed in a metal building (actually a railroad caboose). Control and recording power was from a diesel generator located beside the caboose. Data was recorded from 22 lightning flashes containing more than 80 return strokes. The maximum peak stroke current was 52 kA. Typical data is presented. 8 refs., 13 figs., 1 tab.

43678 **(SAND—88-0079) Switchable, auto gain amplifier.** Phipps, G.S.; Schaefer, J.P. (Sandia National Labs., Albuquerque, NM (USA)). May 1988. Contract AC04-76DP00789. 15p. NTIS, PC A03/MF A01;1; GPO Dep. Order Number DE88012114/JAW.

An electronic amplifier capable of automatically reducing its gain to avoid output saturation is described. Design goals, electrical schematic, and samples of output waveforms are included. 5 figs.

43679 **(SAND—88-0277C) Low-impedance, high-voltage direct drive transformer system.** Rohwein, G.J. (Sandia National Labs., Albuquerque, NM (USA)). 1988. Contract AC04-76DP00789. 18p. (CONF-880699—4). NTIS, PC A 03; 3; GPO Dep. Order Number DE88011790/JAW.

From 18. power modulator symposium; Hilton Head, SC, USA (20 Jun 1988).

High voltage pulsed power systems suitable for space, airborne and mobile ground applications will have the common requirements for light weight and low volume. One method that can significantly reduce the weight and volume of present systems is to eliminate the pulse forming transmission lines and drive the loads directly from the output of a pulse transformer. While simple and attractive in concept, this approach imposes some difficult requirements on the transformer characteristics, its high voltage endurance and reliability. In this paper, the basic design for a 1000 kV, rep rated direct drive transformer system is presented and solutions to the problems of high magnetic coupling and minimum droop characteristics proposed.

43680 **(SAND—88-0359) Rolamite roller dragging evaluation.** Gonzales, A. (Sandia National Labs., Albuquerque, NM (USA)). Mar 1988. Contract AC04-76DP00789. 68p. NTIS, PC A04/MF A01;1; GPO Dep. Order Number DE88008635/JAW.

Some of the small rolamites have experienced a minor (1% to 2%), but persistent failure rate due to the rollers dragging on the case wall after certain lateral shock and vibration environments. In the past, this problem has been attributed to particulate contamination (including ice) and/or poor band alignment. This paper addresses the effect of geometric characteristics including band alignment which may contribute to roller dragging and failure of a rolamite. 2 refs., 11 figs., 2 tabs.

43681 **(SAND—88-1027C) Test structures for total dose testing of SOI [silicon-on-insulator] mosfets.** Fleetwood, D.M.; Tsao, S.S. (Sandia National Labs., Albuquerque, NM (USA)). 1988. Contract AC04-76DP00789. 16p. (CONF-880492—1). NTIS, PC A03/MF A01;1; GPO Dep. Order Number DE88008473/JAW.

From DNA/HDL workshop on test structures for semiconductor device hardening and hardness assurance; Los Angeles, CA, USA (7 Apr 1988).

Simple test structures are described that are useful for optimizing the radiation hardness of, and devloping test methods for, silicon-on-insulator integrated circuits. "Island-edge" and edgeless n-channel transistors have been fabricated in SIMOX (Separation by Implanted Oxygen) and ZMR (Zone-Melt Recrystallized) material. The island-edge structures were formed with or without hardened sidewall isolation. By comparing the radiation results of these structures, we are able to clearly discriminate top-gate, sidewall, and back-gate parasitic leakage, all of which are very important to control in an ionizing radiation environment. With the application of -5 V substrate bias during irradiation, transistors in SIMOX and ZMR with hardened sidewalls exhibited acceptable characteristics at total doses in excess of 1.0 Mrad(Si). We have also used these test structures to compare the response of SOI transitors to Co-60 and 10-keV x-ray irradiation. We find that as expected from previous studies of oxides of similar thickness, the top-gate and sidewall insulator responses to Co-60 and 10-keV x-ray irradiation differ by less than 20 percent for the ZMR and SIMOX devices. Back-gate response, on the other hand, differed significantly for the two sources. For the SIMOX transistors, with 0.4 μm buried insulator thickness, the Co-60 irradiation induced up to a 50% overresponse (in terms of back-channel threshold voltage shifts, with O V back-gate bias applied during irradiation), relative to 10-keV x-rays. For the ZMR transistors, with 2.0 μm buried insulator thickness, the Co-60 response exceeds the x-ray response by up to a factor of 3.

43682 **(UCID—21376) The design of a digital Eprom oscillator for electrical impedance tomography.** Pihlman, M. (Lawrence Livermore National Lab., CA (USA)). Apr 1988. Contract W-7405-ENG-48. 13p. NTIS, PC A03/MF A01;1; GPO Dep. Order Number DE88012243/JAW.

This paper presents the design and operation of an Eprom logic oscillator for an Electrical Impedance Tomography (EIT) imaging tool currently being used to image biological subjects at LLNL. Due to very low injection signal levels and relatively high noise present in biological subjects, it is very important that an EIT imaging device (also known as an {open+-quotes}Impedance Camera{close+-quotes}) be designed to recover amplitude (and phase) information from a noisy received signal and that the noise generated by the system be minimized. The ability to detect small received signals masked by noise requires a comparison of the transmitted signal to the noisy received signal and precise timing to {open+-quotes}synchronize{close+-quotes} these two signals. System noise can be reduced by synchronizing the application of the sinewave (to the subject) to the zero volt crossings of the transmitted sinewave. To address these demands, an Eprom oscillator was designed that not only generates an accurate 10khz to 50khz transmit sinewave, but, also, controls the switching of the sinewave (to coincide with its zero crossings), and generates accurately timed, adjustable, in-phase and quadrature, signals to assist in demodulating the noisy received signal. 2 refs., 7 figs.

43683 **Minority-carrier lifetime in ITO/InP heterojunctions.** Ahrenkiel, R.K.; Dunlavy, D.J.; Hanak, T. (The Solar Energy Research Institute, Golden, Colorado 80401). *Journal of Applied Physics;* **64**: No. 4, 1916-1921(15 Aug 1988).

The relationship between photoluminescence lifetime and minority-carrier lifetime is derived for window/absorber heterojunctions by the method of Laplace transforms. The model includes the effects of diffusion to the depletion region and self-absorption of the emitted radiation. The model is applied to InP photoluminescence generated by pulsed laser excitation of indium-tin-oxide (ITO)/InP heterojunctions. The photoluminescence lifetime of a device with N/sub A/ = 1 x 10^{16} cm^{-3} is about 21 ns. The bulk lifetime of the device can be fit with a lifetime of about 30 ns. The lifetime in the unprocessed substrate exceeds 200 ns indicating that recombination is induced by ITO processing.

43684 **Characterization of device parameters in high-temperature metal-oxide-semiconductor field-effect transistors in β-SiC thin films.** Palmour, J.W.; Kong, H.S.; Davis, R.F. (Department of Materials Science and Engineering, Box 7907, North Carolina State University, Raleigh, North Carolina 27695-7907). *Journal of Applied Physics;* **64**: No. 4, 2168-2177(15 Aug 1988).

Both inversion- and depletion-mode n-channel metal-oxide-semiconductor field-effect transistors (MOSFETs) have been fabricated on β-SiC thin films grown by chemical-vapor deposition. The inversion-mode devices were made on in situ doped (Al) p-type β-SiC(100) thin films grown on Si(100) substrates. The depletion-mode MOSFETs were made on n-type β-SiC(111) thin films grown on the Si(0001) face of a 6H α-SiC substrates. Stable saturation and low subthreshold currents were achieved at drain-source voltages exceeding 5 and 25 V for the inversion-mode and depletion-mode devices, respectively. The transconductance increased with temperature up to 673 K for the short-gate-length devices, of either mode, and then decreased with further increases in temperature. It is proposed that the transconductances and threshold voltages for the inversion-mode devices are greatly affected by minority-carrier injection from the source. Stable transistor action was observed for both types of devices at temperatures up to 823 K, with the depletion-mode devices operating very well up to 923 K.

4209 Waste Processing Plants And Equipment

43685 (CONF-871075—Vol.1-Pt.3, pp 251-253) **Reduction of hazardous solvent wastes through the application of a mobile solvent recovery system.** Keener, T.C. (Univ. of Cincinnati, OH (USA)). 1987. NTIS, PC A18/MF A01. Order Number DE88007805/JAW.

From 3. Oak Ridge model conference on waste problems; Oak Ridge, TN, USA (13 Oct 1987).

A novel mobile solvent recovery system for reclaiming usable solvents and thereby minimizing the amount of waste generation has been developed and tested at a number of industrial sites. The system has been designed to have the flexibility of reclaiming a wide variety of industrial solvents while still adhering to EPA's regulations governing the quantities of wastes which remain

within the system as residue, and minimizing the amount of cross-solvent contamination. It employs a specially engineered vacuum distillation unit equipped with two unique cleaning systems for continuous cleaning of the side walls and dome head. The paper will discuss the current progress of this project including the design and construction of the system and its operation. Results will be given from a field test verification study conducted on various solvent containing wastes, generated from a number of industrial sources. The wastes tested have consisted of sludges with solvents such as toluene, trichloroethane, n-propyl acetate, MEK, xylene, acetone, methylene chloride and others. The results to date have been very promising and indicate that from 50-90% of the initial volume of these wastes may be reduced and that reusable solvent may be obtained, thereby providing an economic, as well as a waste management incentive for on-site reclamation.

43686 **(EMR/FR—TB134) Equipment for incineration of municipal waste.** Friedrich, F.D. (Department of Energy, Mines and Resources, Ottawa, Ontario (Canada). Fuels Research Centre). Apr 1971. 64p. (CE—01613). CANMET/TID, Energy, Mines and Resources Canada, 555 Booth St., Ottawa, Ont., Canada K1A 0G1; $0.34CAN per page, $3.40 CAN minimum.

Incineration offers one method of coping with the rapidly increasing quantitites of solid municipal waste, but incinerators must be carefully designed and operated to avoid air pollution. Some of the North American codes governing incinerator construction are outlined, and a range of available equipment is described, from small incinerators suitable for apartment buildings or commercial establishments, to large European systems which produce steam for district heating or power generation. It is pointed out that small incinerators are, essentially, volume reduction devices using substantial quantities of high-quality fuel to support the incineration process, whereas large heat-recovery incinerators use the waste as fuel to produce energy. 18 refs., 16 figs., 8 tabs.

43687 (NUSE—8701, pp 296-299) **Utilization of waste heat from incinerator.** Asano, Katsuichi. (Nagoya Univ., Nagoya, Japan). Feb 1987. (In Japanese). Nago Univ., Nagoya, Japan.

In FY 1985 Report of Nagoya Univ., Research Center for Resource and Energy Conservation.

Direct utilization of a flame in the incinerator was carried out by utilizing a secondary air for incinerating organic waste liquor as a separating layer between the flame and the heat exchanger. An energy-saving high-purity distilled water production system was realized which continuously operated for more than 2 years, wherein the heat exchanger exposed to severe corrosive gas atmosphere in the incinerator was not corroded and the temperature was suitably controlled for the evaporation of water. This unit needs nothing but 10 l/d of water, and one-tenth of combustible organic waste liquor can be recovered as distilled water. Distilled water made by this system has quite high purity, in spite of a simple distillation, being in between the two exensive type of distilled water, which are respectively for the high purity and the ultra-high purity. This is attributable to the following reasons: 1. Pretreatment of city water by a cylinder of active-carbon plate filter. 2. No entrainment of fine mist. 3. Non-contaminating equipment material used such as hard glass or teflon. (7 figs, 1 tab)

4210 Combustion Systems

REFER ALSO TO CITATION(S) 42610, 43399, 43400

43688 **(DOE/BP/61196—1) Environmental impacts of advanced biomass combustion systems: Final report.** (USDOE Bonneville Power Administration, Portland, OR; OMNI Environmental Services, Inc., Beaverton, OR (USA)). Jan 1988. Contract AC79-86BP61196. 212p. NTIS, PC A10;3. Order Number DE88008501/JAW.

This project was conducted to quantify the emissions from advanced technology small-scale biomass combustors relative to conventional woodstoves. Five devices were tested: a catalytic stove, a pellet fuel stove, a naturally-drafted refractory stove, a conventional stove, and a small institutional boiler retrofitted to burn pellet fuel. Each device was operated at high and low heat outputs and tested for atmospheric emissions and ash residues. Particulate emission testing consisted of gravimetric measurements and quantification of polycyclic aromatic hydrocarbons (PAH), total carbon, pH, acidity, and toxicitymutagenicity. Measurements of gas-phase emissions included volatile organic compounds (VOC), NO/sub x/, SO_2, and CO. Ash residues were tested for elemental composition, total carbon, and solubility. Emissions from each of the advanced technology stoves were compared to emissions from the conventional woodstove. The pellet fuel boiler, while not directly comparable to the residential heaters, was evaluated with the other combustor systems. In general, the advanced technology devices showed significant reductions, relative to the conventional stove, of most pollutant emissions. Emission reductions of several orders of magnitude were recorded for particulate material, VOC, PAH, and acidity for some of the test stoves. All particulate emission samples were toxic, and several showed mutagenic responses. The advanced technology stoves appear to offer significant environmental impact reductions for virtually all the tested parameters.

43689 (INIS-mf—11044, pp 136-147) **Design of a control system for an electric arc vacuum furnace.** Pacheco Sotelo, J. (Instituto Nacional de Investigaciones Nucleares, Mexico City). 1985. (In Spanish). NTIS (US Sales Only), PC A07/MF A01. Order Number DE88780072/JAW. (CONF-8508261—).

From Seminar of the Division of Materials and Testing; Salazar, Mexico (23 Aug 1985).

The theoretical aspects of an electric arc vacuum furnace are discussed, and the achievements to date at ININ in the design of an appropriate control system are presented.

43690 **Catalytic igniters and their use to ignite lean hydrogen-air mixtures.** McLean, W.J.; Thorne, L.R.; Volponi, J.V. (to Dept. of Energy, Washington, DC). US Patent 4,741,879. 3 May 1988. Filed date 10 Jun 1986. vp. Patent and Trademark Office, Box 9, Washington, DC 20232.

This patent describes a catalytic igniter adapted for igniting a confined lean hydrogen-air gaseous mixture in a containing structure comprised of: (a) a non-combustible perforate catalytic substrate through which such a gaseous mixture can freely flow by convection current, about with a pressure drop of less than 0.2 atm, and having a catalytically active surface or surface coating with surface area of at least about 50m/sup 2//g, effective to raise the temperature of the substrate from ambient temperature to above about 80°C. within 200 seconds after the substrate is contacted with such a gaseous mixture; and (b) at least one catalytically active platinum surfaced metal wire mounted, in a thermally conductive manner, on the portion of substrate which becomes heated when contacted with a lean hydrogen-air gaseous mixture when the igniter is mounted in the substrate.

4220 Underground Engineering

43691 (CONF-871075—Vol.1-Pt.3, pp 313-332) **Disposal barriers that release contaminants only by molecular diffusion.** Daniel, D.E.; Shackelford, C.D. (Univ. of Texas, Austin (USA)). 1987. NTIS, PC A18/MF A01. Order Number DE88007805/JAW.

From 3. Oak Ridge model conference on waste problems; Oak Ridge, TN, USA (13 Oct 1987).

Engineered barriers that retard the release of contaminants from land disposal facilities have traditionally been designed solely on the permeability of the material. However, even barriers with a permeability of zero will not stop the release of contaminants because flow will still occur from molecular diffusion of contaminants across the barrier. Many engineers and scientists have ignored the release of contaminants via molecular diffusion either out of lack of knowledge of this transport process or in the belief that rates of release would be insignificant. However, with increasing concern over the effects of ground water contaminant and improved techniques for detecting minute concentrations of pollutants in ground water, there is heightened realization that all transport processes, including molecular diffusion, must be considered. A barrier which allows escape of pollutants only by molecular diffusion is the best that can be built. There are several ways to make a barrier essen-

tially a diffusion barrier, including the use of extremely low-permeability materials and inward hydraulic gradients. The analysis of release rates associated with diffusion is relatively straightforward because the diffusion coefficient is known fairly accurately for many materials. The uncertainty in the diffusion coefficient is much less than the typical uncertainty in permeability.

4230 Marine Engineering

43692 (DTH-ISVA-PR—65) [Vibrations of Pipelines]. Progress report. (Danmarks Tekniske Hoejskole, Lyngby. Inst. for Stroemningsmekanik og Vandbygning). 1987. 62p. NTIS (US Sales Only), PC A04/MF A01. Order Number DE88753323/JAW.

The in-line vibrations of pipelines are investigated. (BCS)

4240 Pollution Control Equipment

43693 (NIVA-O—86218) Instrumentation and sampling methods for the simple control of outlets to air and water. Wathne, B.M.; Hovind, H. (Norsk Inst. for Vannforskning, Oslo). Jan 1987. 31p. (In Norwegian). NTIS (US Sales Only), PC A03/MF A01. Order Number DE88752094/JAW.

The report deals with simple sampling and determination methods for the discharging pollutants to air and water. Methods for the determination of discharges of volumes of nitrogen oxides, carbon monoxide, sulfur dioxide, and hydrocarbons to air are discussed. In connection with the effluents to water, the sampling procedures for the determination of physical/chemical parameters, main inorganic components, metals, heavy metals, general materials specifications, and some other specifications of the chemical compositions are discussed. The equipments and methods used for the ph and conductivity measurements are described. 3 tables.

43 PARTICLE ACCELERATORS

4301 Design, Development, And Operation

REFER ALSO TO CITATION(S) 43727, 43953, 44075

43694 (BNL—41349) Superconducting magnet designs for the SSC and RHIC. Thompson, P.A.; Cottingham, J.; Dahl, P.; Brown, D.; Garber, M.; Ghosh, A.K.; Goodzeit, C.; Greene, A.; Hahn, H.; Herrera, J. (Brookhaven National Lab., Upton, NY (USA)). 1988. Contract AC02-76CH00016. 12p. (CONF-880466—9). NTIS, PC A 03; 3; GPO Dep. Order Number DE88012137/JAW.

From Conference on superconductivity and applications; Buffalo, NY, USA (18 Apr 1988).

This paper reviews the main dipoles for RHIC, which are 9.7 meters long with an operating field of 3.45 T. Four full size dipoles have been tested and all exceeded the operating field. The main dipoles for the SSC project are 17 meters in length with an operating field of 6.6 T. Five of these have been tested. Rough calculations show that the possibility of operating future such large colliders at ~ 80 K instead of ~ 4 K is unlikely to have a major impact upon their cost or feasibility. However, increasing the critical field of practical superconductors (either by lowering the operating temperature of further conductor development) could have a major impact upon the specialized magnets used in the intersection regions of such machines.

43695 (BNL—41384) The Relativistic Heavy Ion Collider at Brookhaven. Hahn, H. (Brookhaven National Lab., Upton, NY (USA)). 1988. Contract AC02-76CH00016. 9p. (CONF-880695—20). NTIS, PC A02. Order Number DE88012885/JAW.

From 1. European particle accelerator conference; Rome, Italy (7 Jun 1988).

The conceptual design of a Relativistic Heavy Ion Collider (RACK) to be constructed in the existing 3.8 km tunnel at Brookhaven has been developed. The collider has been designed to provide collisions of gold ions at six intersection points with a luminosity of about 5 {times} 10^{26}cm/sup {minus}2/sec/sup {minus}1/ at an energy of 100 GeV/u in each beam. Collisions with different ion species, including protons, will be possible. The collider consists of two interlaced, but otherwise separate, superconducting magnet rings. The 9.7 m long dipoles will operate at 3.5 T. Their 8 cm aperture was determined by the dimensions of gold ion beams taking into account diffusion due to intrabeam scattering. Heavy ion beams will be available from the Tandem Van de Graaff/Booster/AGS complex. The salient design features and the reasons for major design choices of the proposed machine are discussed in this paper. 24 refs., 7 figs., 2 tabs.

43696 (FNAL-TM—1525) A new collider upgrade proposal: Increasing the pbar-p collider energy. Johnson, R.P. (Fermi National Accelerator Lab., Batavia, IL (USA)). 23 May 1988. 7p. NTIS, PC A02/MF A01; 1; GPO Dep. Order Number DE88012724/JAW.

An upgrade to the pbar-p collider is proposed which involves replacing the present superconducting Tevatron magnets with higher field magnets. Dipole fields of 8.8 Tesla give 2 TeV on 2 TeV for an estimated cost of less than $200M. Luminosity projections are made with suggestions for additional improvements.

43697 (IAE—4438/2) Production and use of megavolt neutron beams with ΔE/sub n//E/sub n/ ~ 5.10/sup -4/. Lebedeva, N.S.; Morozov, V.M.; Zubov, Yu.G. (Gosudarstvennyj Komitet po Ispol'zovaniyu Atomnoj Ehnergii SSSR, Moscow. Inst. Atomnoj Ehnergii). 1987. 23p. NTIS (US Sales Only), PC A03/MF A01. Order Number DE88703502/JAW.

A method of producing MeV neutron beams with a small neutron energy spread in the beam is described. This method uses a combination of unique properties of deuteron electrostatic accelerators (ESA) and a foilless gas target. The latter allows to realize continuous and easily controllable reproduction of targets with a low energy "thickness" on the basis of differential pumping out of the target working medium vapour by freezing it out in refrigerators with the help of liquid nitrogen. 10 refs.; 5 figs.

43698 (ITEF—160(1987)) Accelerating structures with alternating-phase focusing for light ion acceleration on the I-2 proton injector. Vinogradskij, N.N.; Gusev, M.L.; Dyadin, A.Yu. and others. (Gosudarstvennyj Komitet po Ispol'zovaniyu Atomnoj Ehnergii SSSR, Moscow. Inst. Teoreticheskoj i Ehksperimental'noj Fiziki). 1987. 27p. (In Russian). NTIS (US Sales Only), PC A03/MF A01. Order Number DE88703599/JAW.

Problems on application of the alternating-phase focusing (APF) accelerating system as a channel of preliminary ion acceleration with 1/2-1/4 specific charge on the ITEP I-2 linear proton injector-synchrotron are considered. Accelerating-focusing channels for α-particles with the 5 MeV/m acceleration rate and for He/sub 4//sup +/ ions with the 8 MeV/m acceleration rate per 1.5 MeV/nucl. are described. The optimum scheme of helium ion acceleration using charge-exchange at the output of the APF additional section and further He/sub 4//sup 2+/ ion acceleration in the second resonator of the I-2 accelarator is chosen and substantiated. He/sub 4//sup 2+/ ion beam with 10/sup 10/ particle intensity at 24 MeV/nucleus is obtained as a result of experiments at the input of the synchrotron ring. 16 refs.; 8 figs.; 6 tabs.

43699 (JINR—9-87-364) JINR synchrophasotron. Operation and improvement. 4 quarter 1986. Balandikov, A.N.; Buldakovskij, V.N.; Voevodin, M.A. and others. (Joint Inst. for Nuclear Research, Dubna (USSR). Lab. of High Energy). 1987. 9p. (In Russian). NTIS (US Sales Only), PC A02/MF A01. Order Number DE88703649/JAW.

Information on the operation of the Dubna synchrophasotron in quarter 4, 1986 and in 1986 is presented. Comparative data obtained over a period of the last fifteen years are also given. When a CO/sub 2/ laser ion source is used as an injector, the number of nuclei injected into the accelerator can be increased. This allows the intensity of accelerated nuclei to be increased significantly. The apparatus for absolute measurements of an extracted beam of nuclei

has been constructed. It was calibrated in a beam of carbon nuclei of low intensity. Absolute measurements of the intensity of single-charged particles from 10/sup 5/ to 10/sup 12/ per cycle can be performed with an error of no more than +- 3%. To obtain the socalled "structureless"extraction, a set of devices has been put into operation. These devices made it possible to increase the effective duration of slow extraction. A new circuit of electronics has been constructed to measure the intensity of an injected beam. 4 refs.; 3 figs.; 4 tabs.

43700 (KEK—87-20, pp 256-271) **Status and prospect of the SSC.** Kondo, Takahiko. (National Lab. for High Energy Physics, Oho, Ibaraki (Japan)). Nov 1987. NTIS (US Sales Only), PC A12/MF A01. Order Number DE88780084/ JAW. (CONF-8705290—).

From Meeting on physics at TeV energy scale; Oho, Japan (28 May 1987).

The SSC (Superconducting Super Collider) is an accelerator project for studying pp interactions at the energy of $\sqrt{s} = 40$ TeV, the highest energy ever proposed. The SSC project is briefly described, including the accelerator design, the present status, its physics potentialities and experimental aspects.

43701 **(NIIEFA-P-SIU—0748) Microsecond accelerator for study on the interaction of electron beam with materials.** Bol'shakov, E.P.; Komarov, O.L.; Lazarenko, A.V.; Pecherskij, O.P.; Chebukov, E.S.; Ehngel'ko, V.I. (Nauchno-Issledovatel'skij Inst. Ehlektrofizicheskoj Apparatury, Leningrad (USSR)). 1987. 18p. (In Russian). NTIS (US Sales Only), PC A03/MF A01. Order Number DE88703799/ JAW.

Temperature fields generated during interactions of a pulsed electron beam with the surface of different materials are calculated. The choice of parameters of a pulsed electron accelerator for heat treatment is grounded. The design of a high-current pulsed accelerator with a multipoint cathode is described. The experimental results have shown that the accelerator enables to produce a beam of about 40 mm diameter with electron energy of up to 160 keV, average current density of >10 A/cm/sup 2/ with pulse duration controlled in a wide range. The electron beam with such parameters can heat metallic surfaces up to the melting point for about 20 μs that corresponds to the heating rate of about 10/sup 8/ Ks/sup -1/. The cooling rate is defined by thermophysical parameters of materials, and according to the calculations it can reach. 31 refs.; 9 figs.; 1 tab.

43702 **Recirculating electron beam linac.** Tucker, W.K.; Shope, S.L.; Hasti, D.E. (Sandia National Labs., Albuquerque, NM (US)). pp 957-959 of Proceedings of the 1987 IEEE particle accelerator conference: Accelerator engineering and technology. Lindstrom, E.R.; Taylor, L.S. Piscataway, NJ; IEEE Service Center (1987). (CONF-870302—).

From Particle accelerator conference; Washington, DC, USA (16 Mar 1987).

One method to achieve a high gradient, linear induction accelerator is to recirculate the electron beam in phase with a repeating accelerating voltage. A two-cavity recirculating accelerator has been designed and operated in a single-pass mode. The prototype accelerator uses a 2.0-MV, 10-kA, 25-ns duration injector and an accelerating cavity that will produce a total accelerating voltage of 5.3 MV for four passes. The design of this machine involved key areas of development in pulsed power, specifically, low-jitter spark gaps and vacuum-liquid interfaces for bipolar electric fields. The recirculation technique under investigation employs an ion focus regime (IFR) electrostatic channel created by a magnetically guided, 300-V, 800-mA electron beam in low pressure (0.10 mTorr) Argon gas. This paper discusses the recirculation concept, machine design parameters and scaling relationships, and summarizes the pulsed power issues.

43703 **Application of online modeling to the operation of SLC.** Woodley, M.D.; Sanchez-Chopitea, L.; Shoaee, H. (Stanford Linear Accelerator Center, Stanford Univ., Stanford, CA (US)). pp 722-724 of Proceedings of the 1987 IEEE particle accelerator conference: Accelerator engineering and technology. Lindstrom, E.R.; Taylor, L.S. Piscataway, NJ; IEEE Service Center (1987). (CONF-870302—).

From Particle accelerator conference; Washington, DC, USA (16 Mar 1987).

Online computer models of first order beam optics have been developed for the commissioning, control and operation of the entire SLC including Damping Rings, Linac, Positron Return Line and Collider Arcs. A generalized online environment utilizing these models provides the capability for interactive selection of a desire optics configuration and for the study of its properties. Automated procedures have been developed which calculate and load beamline component set-points and which can scale magnet strengths to achieve desired beam properties for any Linac energy profile. Graphic displays facilitate comparison of design, desired and actual optical characteristics of the beamlines. Measured beam properties, such as beam emittance and dispersion, can be incorporated interactively into the models and used for beam matching and optimization of injection and extraction efficiencies and beam transmissions. The online optics modeling facility also serves as the foundation for many model-driven applications such as autosteering, calculation of beam launch parameters, emittance measurement and dispersion correction.

43704 **Computer control of the energy output of a klystron in the SLC.** Jobe, R.K.; Browne, M.J.; Flores, M.; Phinney, N.; Schwarz, H.D.; Sheppard, J.C. (Stanford Linear Accelerator Center, Stanford Univ., Stanford, CA (US)). pp 735-737 of Proceedings of the 1987 IEEE particle accelerator conference: Accelerator engineering and technology. Lindstrom, E.R.; Taylor, L.S. Piscataway, NJ; IEEE Service Center (1987). (CONF-870302—).

From Particle accelerator conference; Washington, DC, USA (16 Mar 1987).

Hardware and software have been developed to permit computer control of the output of high power klystrons on a pulsed basis. Control of the klystron output is accomplished by varying the input drive via a pulsed RF attenuator. Careful power calibrations permit accurate calculation of the available energy, as seen by the beam, over the full range of the klystorn output. The ability to control precisely the energy output allows for energy feed-forward as well as energy feedback applications. Motivation for this work has been the need to adjust the energy of beams launched into various regions of the SLC. Vernier klystons play a crucial role in the energy delivered from the SLC injector, linac, and positron source. This paper discusses the hardware development, energy calculations, and software implementation. Operational results are presented.

43705 **Control of stochastic cooling and RF systems using interactive graphics.** Mayer, G.; Beck, S.; Pasquinelli, R. (Fermi National Accelerator Lab., P.O. Box 500, Batavia, IL (US)). pp 738-740 of Proceedings of the 1987 IEEE particle accelerator conference: Accelerator engineering and technology. Lindstrom, E.R.; Taylor, L.S. Piscataway, NJ; IEEE Service Center (1987). (CONF-870302—).

From Particle accelerator conference; Washington, DC, USA (16 Mar 1987).

The anti-proton source at Fermilab uses an interactive color graphics system to control the stochastic cooling and RF systems. This general purpose graphic control system provides an intuitive, powerful, and flexible person machine interface to the accelerator systems. The graphics interpreter translates user generated files which specify the location and type of symbol, and displays a live schematic of an accelerator system on a color graphics monitor. The system provides both static symbols, which can be used to generate a schematic, and dynamic symbols which display real time data and provide control. Experience has shown that this method of control has many advantages over simple text displays and has the flexibility necessary to be an important tool in accelerator control.

43706 **Distributed data access in the LAMPF control system.** Schaller, S.C.; Bjorklund, E.A. (Los Alamos National Lab., Los Alamos, NM (US)). pp 745-747 of Proceedings of the 1987 IEEE particle accelerator conference: Accelerator engineering and technology. Lindstrom, E.R.; Taylor, L.S. Piscataway, NJ; IEEE Service Center (1987). (CONF-870302—).

From Particle accelerator conference; Washington, DC, USA (16 Mar 1987).

The authors extended the Los Alamos Meson Physics Facility (LAMPF) control system software to allow uniform access to data and controls throughout the control system network. Two aspects of this work are discussed here. Of primary interest is the use of standard interfaces and standard messages to allow uniform and easily expandable inter-node communication. A locally designed remote procedure call protocol will be described. Of further interest is the use of distributed databases to allow maximal hardware independence in the controls software. Application programs use local partial copies of the global device description database to resolve symbolic device names.

43707 **Feedback systems in the SLC.** Thompson, K.A.; Jobe, R.K.; Johnson, R.; Phinney, N. (Stanford Linear Accelerator Center, Stanford Univ., Stanford, CA (US)). pp 748-750 of Proceedings of the 1987 IEEE particle accelerator conference: Accelerator engineering and technology. Lindstrom, E.R.; Taylor, L.S. Piscataway, NJ; IEEE Service Center (1987). (CONF-870302—).

From Particle accelerator conference; Washington, DC, USA (16 Mar 1987).

Two classes of computer-controlled feedback have been implemented to stabilize parameters in subsystems of the SLC: (a) "slow" (time scales — minutes) feedback, and (b) "fast", i.e., pulse-to-pulse, feedback. The slow loops run in a single FEEDBACK process in the SLC host VAX, which acquires signals and sets control parameters via communication with the database and the network of normal SLC microprocessors. Slow loops exist to stabilize beam energy and energy spread, beam position and angle, and timing of kicker magnets, and to compensate for changes in the phase length of the rf drive line. The fast loops run in dedicated microprocessors, and may sample and/or feedback on particular parameters as often as every pulse of the SLC beam. The first implementations of fast feedback are to control transverse beam blow-up and to stabilize the energy and energy spread of bunches going into the SLC arcs. The overall architecture of the feedback software and the operator interface for controlling loops are discussed.

4302 Beam Dynamics, Field Calculations, And Ion Optics

REFER ALSO TO CITATION(S) 44331

43708 **(BNL—41370) Recent experience in accelerating polarized beam at the AGS.** Ratner, L.G. (Brookhaven National Lab., Upton, NY (USA)). 1988. Contract AC02-76CH00016. 7p. (CONF-8805142—6). NTIS, PC A02/MF A01; 1; GPO Dep. Order Number DE88012886/JAW.

From 3. conference on the intersections between particle and nuclear physics; Rockport, ME, USA (14 May 1988).

The most recent operation of the AGS for polarized protons occurred in December, 1987 and January, 1988. The primary purpose during this period was to tune up the accelerator as soon as possible and to provide a usable polarized beam for high energy physics. We succeeded in providing 1--2 {times} 10^{10} polarized protons per pulse at 18.5 GeV/c with an average polarization of 43 +- 3% and a peak of 52%. The conditions for this run differed in some respects from the previous run done in 1986. Due to problems with the main ring power supply, we were forced to use a back-up MG set which was only capable of 60% of the normal field rate of rise. This, of course enhanced the effect of the depolarizing resonances. A second difference was the fact that a complete horizontal and vertical realignment of the ring magnets was done during the 1987 summer shutdown. In addition, the fast pulsed quadrupole positions were readjusted with respect to the equilibrium orbit. It had been suspected that misalignment of these quads was responsible for large transverse emittance growth in both planes. We will look at the effects of these differences, but the bottom line is that the "standard correction techniques" worked as expected. 2 refs., 6 figs.

43709 **(CERN-EP—88-27) Longitudinal electron polarimetry at LEP.** Alexander, G.; Badier, J.; Blondel, A.; Blum, W.; Dallavalle, M.; Plane, D.E.; Treille, D. (European Organization for Nuclear Research, Geneva (Switzerland)). 29 Feb 1988. 30p. (CONF-8711197—2). NTIS (US Sales Only), PC A03; 1; GPO Dep. Order Number DE88012615/JAW.

From Workshop on polarization in LEP; Geneva, Switzerland (9 Nov 1987).

The principle of electron longitudinal polarization measurements in LEP, based on Compton scattering, is described. The laser source and photon detector requirements are discussed and background estimates are given. 15 refs., 10 figs.

43710 **(FNAL/C—88/65) Coupled bunch instability in Fermilab Booster: Longitudinal phase-space simulation.** Bogacz, S.A.; Stahl, S. (Fermi National Accelerator Lab., Batavia, IL (USA)). 9 Jun 1988. Contract AC02-76CH03000. 4p. (CONF-880695—9). NTIS, PC A02/MF A01; 1; GPO Dep. Order Number DE88012676/JAW.

From 1. European particle accelerator conference; Rome, Italy (7 Jun 1988).

The physical presence of vacuum structures can be expressed in terms of a coupling impedance experienced by the beam. The beam environment considered here consist of parasitic higher order modes of the r.f. cavities. These resonances may have high enough Q's to allow consecutive bunches to interact through mutually induced fields. The cumulative effect of such fields as the particles pass through the cavity may be to induce a coherent buildup in synchrotron motion of the bunches, i.e., a longitudinal coupled-bunch instability. The colliding mode operation of the present generation of high energy synchrotrons and the accompanying r.f. manipulations, make considerations of individual bunch area of paramount importance. Thus, a longitudinal instability in one of a chain of accelerators, while not leading to any immediate reduction in the intensity of the beam in that accelerator, may cause such a reduction of beam quality that later operations are inhibited (resulting in a degradation performance). In this paper we employ a longitudinal phase-space tracking code (ESME) as an effective tool to simulate specific coupled bunch modes arising in a circular accelerator. One of the obvious advantages of the simulation compared to existing analytic formalisms, e.g., based on the Vlasov equation, is that it allows consideration of the instability in a self-consistent manner with respect to the changing accelerating conditions. Furthermore this scheme allows to model nonlinearities of the longitudinal beam dynamics, which are usually not tractable analytically. 5 refs., 3 figs.

43711 **(ITEF—172(1987)) HF-field tuning in a four-chamber H-resonator.** Gusev, M.L.; Parshin, I.O. (Gosudarstvennyj Komitet po Ispol'zovaniyu Atomnoj Ehnergii SSSR, Moscow. Inst. Teoreticheskoj i Ehksperimental'noj Fiziki). 1987. 13p. (In Russian). NTIS (US Sales Only), PC A03/MF A01. Order Number DE88703605/JAW.

A new method for field tuning in a H-resonator of an accelerating structure with spatial-homogeneous quadrupole focusing is developed and experimentally tested. This method provides for a computerized processing of data on dependence of operating frequency of resonator and magnetic fields in its chambers on the piston position, and this processing results in determining the piston deepening values, under which magnetic field nonuniformity does not exceed the required values at the operating frequency. Magnetic field and frequency dependences on piston position were measured. After that the values of required piston deepenings were determined using a computer, for the required relative values of magnetic field and frequency. Calculation time using BESM-6 computer did not exceed 5 min. Capabilities of various groups of pistons during the resonator tuning were investigated. 3 refs.; 5 figs.

43712 (JINR—9-87-775) On the influence of random spread axes of leading magnetic field coils on electron-ion ring motion. Kazarinov, N.Yu.; Kazacha, V.I. (Joint Inst. for Nuclear Research, Dubna (USSR). Dept. of New Acceleration Methods). 1987. 9p. (In Russian). NTIS (US Sales Only), PC A02/MF A01. Order Number DE88703655/JAW.

The excitation process of the radial and axial dipole oscillations in the electron-ion rings connected with random spread of axes of the leading magnetic field coils in LUEK-20 relatively to the system axis is analysed and amplitude dependence of this oscillations on the rings and accelerator magnetic system parameters are investigated. It is shown that mean square spread of the coils axes in LUEK-20 should not exceed the value of ~ 0.5 mm. For ring centre displacement relatively to the accelerator axis by 5 mm the amplitude of the excited dipole oscillations is much less than the maximum permissible one. 7 refs.; 5 figs.

43713 (JINR—13-87-571) Requirements on the stability of electron beam and the KUTI-20 adhezator injection system parameters. Kazarinov, N.Yu.; Shcheulin, A.S. (Joint Inst. for Nuclear Research, Dubna (USSR). Dept. of New Acceleration Methods). 1987. 5p. (In Russian). NTIS (US Sales Only), PC A02/MF A01. Order Number DE88703660/JAW.

The influence of amplitude value fluctuations of the collective accelerator system parameters on the stability of electron ring number in the Ne ring on the radius of equilibrium orbit is considered. It is shown that for holding (ΔNe/Ne) value on the 5x10/sup -2/ level it is necessary that variations of the electric and guide magnetic field in the injector, the magnetic fields at the electron ring radius and the product of the electron beam current fluctuation into coupling coefficient K between electron beam and acceleration structure should be not more than 10/sup -3/. The beam emittance and K coefficient decreasing reduces requirements on the constancy of system parameters. 7 refs.

43714 (JINR-R—9-87-703) Dynamic processes at simultaneous acceleration of protons and H/sup -/-ions in a cyclotron. Dmitrievskij, V.P.; Kol'ga, V.V.; Le Kien Thanh; Lomakina, O.V.; Trejbal, Z. (Joint Inst. for Nuclear Research, Dubna (USSR). Lab. of Nuclear Problems; Ceskoslovenska Akademie Ved, Rez. Ustav Jaderne Fyziky). (Joint Inst. for Nuclear Research, Dubna (USSR). Lab. of Nuclear Problems). 1987. 9p. (In Russian). NTIS (US Sales Only), PC A02/MF A01. Order Number DE88703758/JAW.

The results of analytical and numerical investigations of the dynamic processes at the simultaneous acceleration of protons and H/sup -/-ions on an isochronous cyclotron are presented. The numerical calculations have been performed for the U-120M isochronous cyclotron installed in the Institute of Nuclear Physics (Rez, CSSR). It has been shown that in this cyclotron the simultaneous acceleration of protons and H/sup -/-ions is feasible up to the energy of about 35 MeV. 3 refs.; 3 figs.

43715 (JINR-R—9-87-730) Calculation of a focusing structure of a racetrack microtron. Kazarinov, N.Yu.; Molodozhentsev, A.Yu.; Perel'shtejn, Eh.A. (Joint Inst. for Nuclear Research, Dubna (USSR). Dept. of New Acceleration Methods). 1987. 9p. (In Russian). NTIS (US Sales Only), PC A02/MF A01. Order Number DE88703759/JAW.

The problems of electron transverse motion in a racetrack microtron (RTM) are considered. The method of calculation of the RTM focusing structure is proposed. The focusing structure of the 160 MeV RTM consist of bending magnets, an electron linear accelerator (LINAC), drift spaces and two quadrupole doublets aligned with the axis of LINAC. Tolerance on the values of the gradients of the quadrupole lenses are determined. 7 refs.; 9 figs.

43716 (JINR-R—9-87-852) On requirements to the focusing magnetic field in a induction linear accelerator. Aleksakhin, Yu.I.; Kazarinov, N.Yu.; Kazacha, V.I. (Joint Inst. for Nuclear Research, Dubna (USSR)). 1987. 3p. (In Russian). NTIS (US Sales Only), PC A02/MF A01. Order Number DE88703761/JAW.

Submitted to the Organizing Committee of 7. All-Union symposium on high-current electronics, Novosibirsk, May 1988.

Causes reducing coherent beam deflection from a linear induction accelerator (LIA) axis are analysed. The qualitative explanation of the experimentally observed big transverse beam displacenment in high-perveance gridless diodes is suggested. It is shown that the influence on accelerated beam characteristics of both the initial displacement and random spread of the focusing coil position can be made weaker by adiabatic increase in the longitudinal magnetic field strength along the accelerator path. 5 refs.; 1 fig.

43717 (JINR-R—11-87-452) Studying the conditions of betatron oscillation amplitude bounding in the resonance vicinity. Amirkhanov, I.V.; Zhidkov, E.P.; Zhidkova, I.E. (Joint Inst. for Nuclear Research, Dubna (USSR). Lab. of Computing Techniques and Automation). 1987. 16p. (In Russian). NTIS (US Sales Only), PC A03/MF A01. Order Number DE88703771/JAW.

The conditions of bounding the oscillation betatron charge particle amplitudes of the third order resonance vicinity which occur near the working point of the JINR synchrophasotron are investigated. The investigation was performed using Krylov-Bogolyubov method of averaging in third approximation. The evaluations were realized on computer with the help of the REDUCE-3.2 program system for analytical evaluation. At some restrictions imposed on magnetic field parameters the amplitudes bounding is satisfied. 5 refs.

43718 (SLAC-PUB—4626) Periodic solutions of the Hamilton-Jacobi equation by the shooting method: A technique for beam dynamics. Gabella, W.E.; Ruth, R.D.; Warnock, R.L. (Colorado Univ., Boulder (USA); Stanford Linear Accelerator Center, Menlo Park, CA (USA)). May 1988. Contract AC03-76SF00515;FG02-86ER40302. 10p. (CONF-8804111—3). NTIS, PC A02/MF A01; 1; GPO Dep. Order Number DE88012733/JAW.

From 2. ICFA advanced beam dynamics; Lugano, Switzerland (11 Apr 1988).

Periodic solutions of the Hamilton-Jacobi equation determine invariant tori in phase space. The Fourier spectrum of a torus with respect to angular coordinates gives useful information about nonlinear resonances and their potential for causing instabilities. We describe a method to solve the Hamilton-Jacobi equation for an arbitrary accelerator lattice. The method works with Fourier modes of the generating functions, and imposes periodicity in the machine azimuth by a shooting method. We give examples leading to three-dimensional plots in a surface of section. It is expected that the technique will be useful in lattice optimization. 14 refs., 6 figs., 1 tab.

43719 Comparison of the aperture and chromatic aberrations of magnetic round lenses with those of quadrupole doublets. Ling, K.M.; Moses R.W. Jr. (Los Alamos National Laboratory, Los Alamos, New Mexico 87545). *Journal of Applied Physics;* **64**: No. 4, 1640-1645(15 Aug 1988).

The paraxial equation for rotationally symmetric magnetic lenses is integrated numerically by using the Numerov method. The normalized third-order aperture and second-order chromatic aberration coefficients (C_s/sub N/ and C/sub c//sub N/) are calculated. A Fourier representation of the lens field is used, and a search for minimum C_s/sub N/ is carried out by varying the Fourier coefficients. Comparisons with comparable quadrupole doublets, and calculations of C_s/sub N/ and C/sub c//sub N/ for actual coil systems are presented. The main conclusion is that magnetic round lenses are about a factor of 2 better than comparable magnetic quadrupole doublets as far as the third-order aperture aberration is concerned, but the chromatic aberrations in both systems are comparable.

43720 Nonlinear solution for optimal shaping of the driving electron beam in the plasma wake-field accelerator. Yan, Y.T.; Chen, H. (Los Alamos National Laboratory, Los Alamos, New Mexico 87545). *Physical Review* [*Section*] *A: General Physics;* **38**: No. 3, 1490-1494(1 Aug 1988).

We report a nonlinear analytical solution for optimal shaping of the driving electron beam in the plasma wake-field accelerator. The upper bound of the transformer ratio is R/sub u/ = [1+(2πL/sub b//λ/sub p/)²]/sup 1/2/, where L/sub b/ is the length of the driving electron beam, λ/sub p/≅2πc/ω/sub p/, and ω/sub p/ is the plasma frequency.

43721 Detection of coherent transition radiation and its application to beam diagnostics and particle identification. Piestrup, M.A.; Boyers, D.G.; Li, Q.; Moran, M.J.; Buskirk, F.R.; Maruyama, X.K.; Neighbours, J.R.; Robinson, R.M.; Snyder, D.L. (Adelphi Technology, Inc., 532 Emerson Street, Palo Alto, CA (US)). *IEEE (Institute of Electrical and Electronics Engineers) Transactions on Nuclear Science;* 35: No. 1, 464-469(Feb 1988). (CONF-871006—).

From 34. nuclear science symposium and 19. nuclear power systems symposium; San Francisco, CA, USA (21 Oct 1987).

The authors report the first observation of the angular distribution of coherent (resonant) transition radiation at soft-x-ray photon energies (1 keV to 3 keV). Previous investigators observed coherent emission at energies of 100 eV to 400 V from radiators consisting of 2 or 4 foils of polypropylene or boron nitride. The authors constructed two different radiators each consisting of stack of 8 foils of 3.5-μm-thick mylar. One of the radiators was designed to demonstrate inter-foil coherence and had foil-to-foil spacing of 8.5 μm throughout the stack. The other radiator had large random spacings that prevented coherent interference between foils. These radiators were irradiated with electron beams with energies ranging from 63 to 97 MeV and their angular distributions were compared. A Hamamatsu linear diode array was used to display the complete angular distribution of the transition radiation of a pulse-to-pulse basis with the accelerator time structure. The distributions were symmetrical around the axis of the transition-radiation cone. For the coherent case the angle of peak photon emission was found to increase with increasing electron-beam energy; for the incoherent case the angle was found to decrease with increasing electron energy. The coherent case is contrary to the normally expected behavior and can be used as the basis of an electron beam-energy diagnostic.

43722 Artificial charging of spacecraft due to electron beam emission. Gussenhoven, M.S.; Mullen, E.G.; Hardy, D.A. (Space Physics Div., Air Force Geophysics Lab., Hanscom AFB, MA (US)). *IEEE (Institute of Electrical and Electronics Engineers) Transactions on Nuclear Science;* NS-34: No. 6, 1614-1621(Dec 1987). (CONF-8707112—).

From Annual conference on nuclear and space radiation effects; Snowmass Village, CO, USA (28 Jul 1987).

Electron beams on a spacecraft can be used to simulate positive charging from energetic ions whether natural (Jovian) or artificial (particle beams). Plasma environment dependent charging effects during electron beam operations on SCATHA are discussed.

43723 Emittance growth in intense beams. Wangler, T.P.; Mills, R.S.; Crandall, K.R. (Los Alamos National Lab., Los Alamos, NM (US)). pp 1006-1010 of Proceedings of the 1987 IEEE particle accelerator conference: Accelerator engineering and technology. Lindstrom, E.R.; Taylor, L.S. Piscataway, NJ; IEEE Service Center (1987). (CONF-870302—).

From Particle accelerator conference; Washington, DC, USA (16 Mar 1987).

Recent progress in the study of high-current, low-emittance, charged-particle beams may have a significant influence in the design of future linear accelerators and beam-transport systems for higher brightness applications. Three space-charge-induced rms-emittance-growth mechanisms are now well established: (a) charge-density redistribution, (b) kinetic-energy exchange toward equipartitioning, and (c) coherent instabilities driven by periodic focusing systems. The authors report the results from a numerical simulation study of emittance in a high-current radio-frequency quadrupole (RFQ) linear accelerator, and present a new semiempirical equation for the observed emittance growth, which agrees well with the emittance growth predicted from numerical simulation codes.

43724 Position, angle and energy stabilization for the SLC positron target and ARCs. Jobe, R.K.; Thompson, K.A.; Almog, I.; Phinney, N.; Seeman, J.T.; Sheppard, J.C.; Shoaee, H. (Stanford Linear Accelerator Center, Stanford Univ., Stanford, CA (US)). pp 713-715 of Proceedings of the 1987 IEEE particle accelerator conference: Accelerator engineering and technology. Lindstrom, E.R.; Taylor, L.S. Piscataway, NJ; IEEE Service Center (1987). (CONF-870302—).

From Particle accelerator conference; Washington, DC, USA (16 Mar 1987).

Slow feedback has been developed to control the position, angle, and energy of the three SLC bunches in the linac at the South Arc, North Arc, and positron target respectively. A set of computer controlled feedback loops calculate the parameters of each bunch from beam position monitor data in the appropriate extraction line. The angles ad positions are corrected by orthogonal sets of steering dipoles. The energy is corrected by adjusting the phase of two upstream sectors of the linac. This paper discusses the data acquisition and algorithms.

43725 The beam optics of the Argonne Positive-Ion Injector. Pardo, R.C.; Shepard, K.W.; Karls, M. (Argonne National Lab., Argonne, IL (US)). pp 1228-1230 of Proceedings of the 1987 IEEE particle accelerator conference: Accelerator engineering and technology. Lindstrom, E.R.; Taylor, L.S. Piscataway, NJ; IEEE Service Center (1987). (CONF-870302—).

From Particle accelerator conference; Washington, DC, USA (16 Mar 1987).

The beam optics for Phase I of the Argonne Positive-Ion Injector linac system have been studied for a representative set of beams. The results of this study indicate that high charge state beams from an ECR source can be accelerated without significantly increasing the transverse or longitudinal emittance of the initial beam. It is expected that the beam quality from the PII-ATLAS system will be at least as good as presently achieved with the tandem-ATLAS system.

43726 Limitation of linear colliders from transverse RF deflections. Seeman, J.T. (Stanford Linear Accelerator Center, Stanford Univ., Stanford, CA (US)). pp 1267-1268 of Proceedings of the 1987 IEEE particle accelerator conference: Accelerator engineering and technology. Lindstrom, E.R.; Taylor, L.S. Piscataway, NJ; IEEE Service Center (1987). (CONF-870302—).

From Particle accelerator conference; Washington, DC, USA (16 Mar 1987).

Offaxis beam trajectories in a linear collider produce transverse wakefield and chromatic effects which cause emittance enlargement. One cause for non-centered trajectories in the accelerating structures is radial RF fields which produce transverse deflections. Static deflections can be compensated by static dipole magnetic fields. However, fluctuations of the RF field cause variations in the deflections which must be managed or limited. Given the level of fluctuation of the phase and amplitude of an RF system, a limit on the allowable RF deflection can be calculated. Parameters such as the beam emittance, lattice design, RF wavelength and the initial and final beam energies influence the tolerances. Two tolerances are calculated: (1) one assumes that the wakefields are completely controlled, and that chromatic effects are the only enlarging mechanism (optimistic), and (2) the other assumes the limit is due to transverse wakefields without the aid of Landau damping (pessimistic).

43727 Invariant surfaces and tracking by the Hamilton-Jacobi method. Warnock, R.L.; Ruth, R.D. (Lawrence Berkeley Lab., Univ. of California, Berkeley, CA (US)). pp 1261-1263 of Proceedings of the 1987 IEEE particle accelerator conference: Accelerator engineering and technology. Lindstrom, E.R.; Taylor, L.S. Piscataway, NJ; IEEE Service Center (1987). (CONF-870302—).

From Particle accelerator conference; Washington, DC, USA (16 Mar 1987).

Methods of nonlinear mechanics based on infinite expansions, such as perturbation theory and the Lie-algebraic method, are

very cumbersome when carried to high orders. A promising alternative is based on iterative numerical solution of the Hamilton-Jacobi equation. In this approach, every iteration is the same calculation, which is not much more complicated than lowest order perturbation theory. In previous work the authors applied the Hamilton-Jacobi method to model problems displaying generic difficulties of nonlinear mechanics. Results concerning accuracy and convergence were encouraging, even in difficult regions of phase space close to the onset of chaos. Furthermore, they formulated a criterion for the onset of chaos, and verified its utility in a two-resonance model. Here the authors illustrate the method for a model of betatron motion in one degree of freedom, namely, an harmonic oscillator perturbed by a lattice of sextupoles. They obtain invariant surfaces in phase space and also finite time symplectic maps for tracking of single particles. The results indicate that the method will be effective in a full treatment with two degrees of freedom, including arbitrary lattice functions and dispersion.

43728 **Fast energy and energy spectrum feedback in the SLC Linac.** Abrams, G.S.; Soderstrom, E.; Seeman, J.T.; Campisi, I.E.; Herrmannsfeldt, W.; Lee, M.; Petersen, A.; Adolphsen, C. (Lawrence Berkeley Lab., Berkeley, CA (US)). pp 1258-1260 of Proceedings of the 1987 IEEE particle accelerator conference: Accelerator engineering and technology. Lindstrom, E.R.; Taylor, L.S. Piscataway, NJ; IEEE Service Center (1987). (CONF-870302—).

From Particle accelerator conference; Washington, DC, USA (16 Mar 1987).

The energies and energy spectra of the position and electron beams emerging from the SLC Linac must be carefully maintained so that the beams can be transported through the Arcs to the Final Focus without phase space dilution and also to specify the collision energy. A fast feedback system has been designed and constructed to control these parameters. The energies and energy spectra are measured nondestructively using position monitors and synchrotron radiation width monitors. The controls consist of RF phases in the Damping Rings, SLED timing, and RF amplitude. Theoretical aspects of the feedback process, algorithms, and operational experience are discussed.

4303 Auxiliaries And Components

REFER ALSO TO CITATION(S) 43702, 43728, 44493, 44494

43729 **(CERN-EP—87-207) The electron cooling device developed for LEAR.** Poth, H.; Habfast, C.; Schwab, W.; Seligmann, B.; Woertge, M.; Wolf, A.; Haseroth, H.; Hill, C.E.; Vallet, J.L. (European Organization for Nuclear Research, Geneva (Switzerland)). 10 Nov 1987. 10p. (CONF-8709160—7). NTIS (US Sales Only), PC A03; 1; GPO Dep. Order Number DE88012605/JAW.

From 4. LEAR workshop; Villars-sur-Ollon, Switzerland (6 Sep 1987).

The development of the low energy electron cooling device is summarized. A description of the electron cooler is given and recent measurements are presented. The cooling performance expected for LEAR is discussed. 18 refs., 2 figs., 1 tab.

43730 **(IFVE-OP—87-78) Studying the low-frequency noise characteristics of stabilitrons.** Kardanev, A.B.; Sushkov, V.V. (Gosudarstvennyj Komitet po Ispol'zovaniyu Atomnoj Ehnergii SSSR, Serpukhov. Inst. Fiziki Vysokikh Ehnergij). 1987. 11p. (In Russian). NTIS (US Sales Only), PC A03/MF A01. Order Number DE88703543/JAW.

Submitted to the journal Instrum. Exp. Tech. .

Investigation results of relation between KC1910 precision stabilizer diode low-frequency noise level and their temperature coefficient of stabilization voltage instability are presented. It is shown, that there is the strong correlative relation of the parameters concerned, that makes the selection of the devices with the lowest temperature coefficient much easier. Stabilizer diodes are thermal-compensated Zener diodes and are the most wide-spread base elements for production of reference voltage stable sources. 10 refs.; 4 figs.

43731 **(IFVE-OUNK—87-174) Calculational analysis of transverse heating processes in accelerating-storage complex superconducting magnets in cooling down and heating up regimes.** Abramov, A.G.; Ageev, A.I.; Baluev, A.B.; Bozhko, Yu.G.; Dajkovskij, A.G.; Zhirnov, A.V.; Tarasov, A.V. (Gosudarstvennyj Komitet po Ispol'zovaniyu Atomnoj Ehnergii SSSR, Serpukhov. Inst. Fiziki Vysokikh Ehnergij). 1987. 12p. (In Russian). NTIS (US Sales Only), PC A03/MF A01. Order Number DE88703548/JAW.

The results of numerical analysis of heating processes in the cross section of the accelerating-storage complex superconducting (SC) dipole in cooling down and heating up modes are presented. The influence of the heat transfer coefficient and thermal resistance between the windings and the yoke on the duration of heating processes in the dipole has been investigated. The peculiarities of the temperature field in the SC-dipole cross section have been exhibited and the temperature drops in the units are quoted. 2 refs.; 8 figs.

43732 **(INS-T—473) TARN rf stacking system.** Watanabe, Shin-ichi; Katayama, Takeshi; Yoshizawa, Morio; Takanaka, Masao; Fujino, Takeo. (Tokyo Univ., Tanashi (Japan). Inst. for Nuclear Study). Sep 1987. 25p. NTIS (US Sales Only), PC A03/MF A01. Order Number DE88753413/JAW.

Repetitive rf stacking system for the TARN was developed. The developed system consists of ferrite loaded rf cavity, rf power amplifier, ferrite bias power supply and low level rf electronics. Ferrite material and rf signal source were studied to obtain a high-duty and precise moving rf bucket. Phase lock technic worked at a low intensity beam was also studied. Repetition rate of 50 Hz and final stacking number of 50 were attained at the injection beam energy of 7 MeV/u.

43733 **(JINR—8-87-658) Cryogenic system of superconducting magnet of DTs-1 deutero n cyclotron.** Alenitskij, Yu.G.; Buzdavin, A.P.; Vasilenko, A.T. and others. (Joint Inst. for Nuclear Research, Dubna (USSR). Lab. of Nuclear Problems). 1987. 14p. (In Russian). NTIS (US Sales Only), PC A03/MF A01. Order Number DE88703648/JAW.

A cryogenic system (CS) is described intended for cooling, cryostating and warming of superconducting magnetic system of the prototype of the magnet of DTs 1 deuteron cyclotron being developed at the Laboratory of Nuclear Problems, JINR. The CS has a two-;oop pattern with the use of a sattellite refrigerator. Its components are the cryogenic helium unit KGU 150/4.5, vessels for liquid helium of TsTG 0.5/0.7 type and for liquid nitrogen of TsTK 0.5/0.25, TsTK 5/0.25, TsTK 8/0.25, a cooling unit, parameter monitoring system. The capabilities of the CS are analysed, and the main calculated parameters are given. The arrangement of the CS equipment is described. 15 refs.; 2 figs.; 2 tabs.

43734 **(JINR—9-87-627) Improvement of control system circuit of high frequency supply of U-400 cyclotron.** Bui Binh Thuan; Boltushkin, V.V.; Gikal, B.N.; Gul'bekyan, G.G.; Ivan'shin, V.A.; Pashchenko, S.V. (Joint Inst. for Nuclear Research, Dubna (USSR). Lab. of Nuclear Reactions). 1987. 5p. (In Russian). NTIS (US Sales Only), PC A02/MF A01. Order Number DE88703651/JAW.

Some improvents of control circuits of the HF source of the U-400 cyclotron are shown: automatic regulation of the amplification output cascade; regulating circuit in the cyclotron chamber and switch-on circuit of radiation technological blocking. 2 refs.; 4 figs.

43735 **(JINR—9-87-723) Effect of stray field, exhaust target and multiple scattering on a gas on parameters of the beam extracted out of the JINR phasotron.** Dmitrievskij, V.P.; Zaplatin, N.L.; Kol'ga, V.V.; Onishchenko, L.M.; Chesnov, A.F.; Chesnova, S.I. (Joint Inst. for Nuclear Research, Dubna (USSR). Lab. of Nuclear Problems). 1987. 6p. (In Russian). NTIS (US Sales Only), PC A02/MF A01. Order Number DE88703652/JAW.

The results of calculations of proton beam emittances for (664+-3.2) MeV energies is described. Magnet stray field dispersion

of the phasotron, Coulomb scattering at exhaust Al targetr and at ionization chamber having 500 mkm full thickness (aluminium) and drift-space 4.5 m long are taken into consideration. It is shown that the effective horizontal and vertical emittances of extracted beam will decrease 1.6 and 1.5 times in the focus point in the beam was transported in vacuum ion chamber from the accelerator to the target. 7 refs.; 3 figs.; 2 tabs.

43736 **(JINR—9-87-755) Heat protection of iron current section of JINR phasotron.** Kalmykov, A.V.; Chesnov, A.F. (Joint Inst. for Nuclear Research, Dubna (USSR). Lab. of Nuclear Problems). 1987. 4p. (In Russian). NTIS (US Sales Only), PC A02/MF A01. Order Number DE88703653/JAW.

The heat protection system for the septum and correction colis of the iron current section (ICS) of the JINR) of the JINR phasotron extraction channel is described. The operating current through the ICS septum coil is 11 kA, the current density is up to 175 A/mm/sup 2/. The current through the correction coil is 3.2 kA, the current density is 45 A/mm/sup 2/. Current coils are cooled with distilled water. To protect the section coils against overheating and to chek the temperature, a method is used which is based on measuring a voltage drop across a part of the coil or the whole coil and on comparing it with the threshold voltage corresponding to the maximum permissible heating temperatures. The protection system responds to any change in the cooling water flow, shortcircuit and allows one to measure temperature of a part of the coil or the whole coil when ICS is in operation. In an emergency the power is cut off in 0.07 sec. 5 refs.; 2 figs.

43737 **(JINR—13-87-633) Multichannel register of the shape of linear induction accelerator pulse signals.** Zhuravlev, V.V.; Zamrij, V.N.; Litvinenko, E.I.; Pikel'ner, T.L.; Samojlov, A.K. (Joint Inst. for Nuclear Research, Dubna (USSR). Lab. of Neutron Physics). 1987. 9p. (In Russian). NTIS (US Sales Only), PC A02/MF A01. Order Number DE88703664/JAW.

The multichannel register of the pulse shape is intended for utilizing during performance of the beam parameter diagnostics for the LIU-30 linear induction accelerator. The register includes the transducer signal extended lines and the isolation pulse transformers, the relay commutator blocks with channel number upto 196 with the followers and adder, the converter of 64 values of the signal into 6-bit codes with the memory; the blocks of registers and of cycle counters, the interface for a colour monitor and the controller for the CAMAC crate communication with the MERA-60 microcomputer. The duration of the signal shape registration cycle is ~ 2.1 μs and the programmable delay cycle is ~ 0-2.1 s. The registration cycles, their data acquisition and channel commutation are synchronized with the period of LIU-30 beam acceleration repetition period. The signal shape of selected group of the 1-6 transducers is output to the monitor screen with the account of the beam path-time and signal relative delays, rating, line approximation, scale and collor, as well as to the printer. The software (16 K words) consists of 6 functional modules. There are the dialogue with operator, (5 control symbols of the terminal). The execution time for registration, acquisition and output to the screen: at the single mode ~ 2 s and at the cycle mode it is determined by the duration of the LIU-30 period. 8 refs.; 4 figs.

43738 **(JINR—13-87-781) DC stabilizer for power supply systems of cyclotron correction coils.** Batmanova, Eh.K.; Kazakova, G.G.; Kalinichenko, V.V. (Joint Inst. for Nuclear Research, Dubna (USSR). Lab. of Nuclear Problems). 1987. 9p. (In Russian). NTIS (US Sales Only), PC A02/MF A01. Order Number DE88703670/JAW.

A block diagram of the computer-controller wide-range degenrative DC stabilizer is discussed. The stabilizer measuring device is based on magnetic comparison of direct currents, the comparison error is 10/sup -4/-10/sup -3/. The main part of the measuring device is a magnetic modulation unit; its diagram and characteristics of cores and coils of the sample operating in the 0-1000 A range are given. Electronics of the measuring device is described in detail. 11 refs.; 5 figs.

43739 **(JINR—13-87-835) Test of combined Cherenkov method for measurement of the mean energy of 660 MeV protons.** Zrelov, V.P.; Kuz'min, E.S.; Lupil'tsev, V.P.; Ruzhichka, Ya. (Joint Inst. for Nuclear Research, Dubna (USSR). Lab. of Nuclear Problems). 1987. 8p. (In Russian). NTIS (US Sales Only), PC A02/MF A01. Order Number DE88703672/JAW.

Submitted to the journal Instrum. Exp. Tech. .

The results obtained in test of a combined Cherenkov device for measurement of the mean energy in the 660 MeV proton beam of the improved phasotron in JINR are presented. The device operates with lower (~ by two orders) proton fluxes than those necessary for the so-called simple Cherenkov method. The main formulae for calculation of the achromatic prism and for the analysis of the results are given. An accuracy is ΔE=+- 0.6 MeV has been achieved. The results of three measurements performed during 1.5 years since the accelerator putting into operation are given. 5 refs.; 4 figs.; 4 tabs.

43740 **(JINR-R—9-87-671) Automated system for designing a cyclotron magnet using the PRAVETS-16 personal computer.** Vorozhtsov, S.B.; Kalinkina, M.B.; Saenko, V.A. (Joint Inst. for Nuclear Research, Dubna (USSR). Lab. of Nuclear Problems). 1987. 6p. (In Russian). NTIS (US Sales Only), PC A02/MF A01. Order Number DE88703757/JAW.

An automated system of input data preparation and analysis of the results is described. It is indended for solving the synthesis problem of isochronous cyclotron magnetic system. The system has been developed on the basis of "PRAVETS-16" personal computer (analogue of IBM-PC/XT) interfaced to JINR host computers (EC-1060/61, CDC-6500, BESM-6) via the JINET local network. Using of this system in interactive mode allowed one to find Apere-turns of main winding and the air gap profile between poles of the spiral sector cyclotron magnet for formation of a desirable mean magnetic field and the flutter. 9 refs.; 8 figs.

43741 **(JINR-R—9-87-763) Proton beam loss evaluation in the injection channel of SPIN synchrotron.** Andreev, V.V.; Alfeev, V.S.; Shelaev, I.A.; Yudin, I.P. (Joint Inst. for Nuclear Research, Dubna (USSR). Lab. of High Energy). 1987. 15p. (In Russian). NTIS (US Sales Only), PC A03/MF A01. Order Number DE88703760/JAW.

Numerical and experimental results of investigation of the 0.5 MeV proton beam transport through the SPIN superconducting synchrotron injection channel are presented for various regimes of operation. Analysis of some results of the "warm" and "cold" startups of the accelerator is given. Some modification of construction and channel parameters by choosing an optimal installation operation regime is proposed. A possibility of increasing the beam intensity at the entrance into the synchrotron ring is established by a computer simulation. 6 refs.; 14 figs.; 2 tabs.

43742 **(JINR-R—13-87-396) TV-camera on the basis of a charge-coupled device for the diagnostics of charged particle beams.** Buriev, N.T.; Voevodin, M.A.; Kovalenko, A.D.; Larin, A.A.; Sajfulin, Sh.Z. (Tadzhikskij Gosudarstvennyj Univ., Dushanbe (USSR)). (Joint Inst. for Nuclear Research, Dubna (USSR). Lab. of High Energy). 1987. 8p. (In Russian). NTIS (US Sales Only), PC A02/MF A01. Order Number DE88703775/JAW.

A digital TV-camera, based on a charge coupled device is described. This camera is intended for the diagnostics of parameters of charged particle beams and is working the measuring system online whith a computer. Threshold intensities for different nuclear beams are presented starting from which one can control beam parameters. 7 refs.; 4 figs.

43743 **Analysis and measurements of permanent magnet "bifilar" helical wigglers.** Ashkenazy, J.; Bekefi, G. (Dept. of Physics and the Research Lab. of Electronics, Massachusetts Institute of Technology, Cambridge, MA (US)). *IEEE (Institute of Electrical and Electronics Engineers) Journal of Quantum Electronics;* **24**: No. 5, 812-819(May 1988).

Analysis and measurements of the permanent magnet "bifilar" helical wiggler, composed of a cylindrical array of staggered bar magnets, are presented. The discreteness of the magnets is taken into account, thus enabling a calculation of the field strengths of the fundamental and higher spatial harmonics. Calculations show that the performance of this wiggler is expected to be comparable or better than that of a planar wiggler with similar parameters. In addition, the authors have studied experimentally and analytically samarium-cobalt-iron hybrids in which soft iron tubes were used to enhance and/or taper the wiggler field amplitude.

43744 **Design and performance of a new positron tomograph.** Muehllehner, G.; Karp, J.S.; Mankoff, D.A.; Beerbohm, D.; Ordonez, C.E. (Univ. of Pennsylvania, Dept. of Radiology, 3400 Spruce Street, Philadelphia, PA (US)). *IEEE (Institute of Electrical and Electronics Engineers) Transactions on Nuclear Science;* 35: No. 1, 670-674(Feb 1988). (CONF-871006—).

From 34. nuclear science symposium and 19. nuclear power systems symposium; San Francisco, CA, USA (21 Oct 1987).

High spatial resolution in a positron tomograph with multislice imaging capability can be achieved by some form of position encoding to avoid the complexity resulting from individual photomultipliers (PMT) coupled to individual small crystals. The authors recently completed a multislice positron tomograph using six large area NaI (T1) crystals coupled to 50-mm square PMTs, which results in a large number of resolution elements with relatively low complexity compared to other approaches. The design and performance of this instrument, which is based on a previously constructed single-slice version, is described in this paper, emphasizing those aspects which differ from other designs.

43745 **Heavy-ion fusion target cost model.** Pendergrass, J.H.; Harris, D.B.; Dudziak, D.J. (Univ. of California, Los Alamos National Lab., P.O. Box 1663, Los Alamos, NM (US)). *Fusion Technology;* 13: No. 2, 375(Feb 1988).

A new model for the cost of production of heavy-ion fusion targets in dedicated on-site target factories is presented for power plants. The model treats single- and double-shell direct-drive and generic indirect-drive targets. Target factory capital costs, nontritium target material costs, and target factory operations and maintenance costs are estimated for target substructures such as fuel capsules, radiation cases, and drier energy absorption regions. These individual estimates are combined to obtain the total target cost. Realistic scaling of target costs with variations of such important performance parameters as target factory production capacity and driver pulse energy is emphasized. The model can be modified and used for other inertial fusion drivers and fuels. Typical target cost estimates fall into the range of /0.25 to 0.45 per target. The estimated target cost contribution to the total cost of production of electric power is typically —4 to 7 mill/kW . h.

43746 **Automated emittance measurements in the SLC.** Ross, M.C.; Phinney, N.; Quickfall, G.; Shoaee, H.; Sheppard, J.C. (Stanford Linear Accelerator Center, Stanford Univ., Stanford, CA (US)). pp 725-728 of Proceedings of the 1987 IEEE particle accelerator conference: Accelerator engineering and technology. Lindstrom, E.R.; Taylor, L.S. Piscataway, NJ; IEEE Service Center (1987). (CONF-870302—).

From Particle accelerator conference; Washington, DC, USA (16 Mar 1987).

The emittance of the SLC beam is determined from measurements of the beam width on a profile monitor as a quadrupole field is varied. An automated system has been developed to allow this to be done rapidly and accurately. The image on a fluorescent screen profile monitor (resolution about 20 μm) is read out through an electronic interface and digitized by a transient recorder. A high level software package has been developed to set up the hardware for the measurements, acquire data, fit the beam width, and calculate the emittance.

43747 **Implementation of nonintercepting energy spread monitors.** Sheppard, J.C.; Bambade, P.S.; Clendenin, J.E.; Gromme, T.E.; Jobe, R.K.; Phinney, N.; Ross, M.C. (Stanford Linear Accelerator Center, Stanford Univ., Stanford, CA (US)). pp 757-759 of Proceedings of the 1987 IEEE particle accelerator conference: Accelerator engineering and technology. Lindstrom, E.R.; Taylor, L.S. Piscataway, NJ; IEEE Service Center (1987). (CONF-870302—).

From Particle accelerator conference; Washington, DC, USA (16 Mar 1987).

Stripline beam position monitors (BPMs), located in regions of large dispersion, are being used to monitor the relative energy spread of beams injected into the SLC damping rings. Several BPMs have been configured so that the quadrupole moment as well as the dipole moment (beam position) information is generated in hardware. The dipole moment is subtracted in quadrature from the quadrupole moment to produce a signal which is related to the beam width but which is independent of the beam position. Data reduction and averaging is accomplished in the control system microprocessors. Additional data handling occurs in the host computer. Beam width signals from the devices are used in conjunction with RF phase adjustments to minimize the energy spread of the beams. A computer controlled feedback loop has been developed to oversee the process of energy spread manipulation.

43748 **A CCD beam profile monitor for 14.6 GeV/amu / sup 16/O ions.** Beavis, D.; Debbe, R.; Le Vine, M.J.; Van Dijk, J.H.; Wegner, H.E.; Ikeda, Y.; Sugitate, T. (Brookhaven National Lab. (US)). pp 707-709 of Proceedings of the 1987 IEEE particle accelerator conference: Accelerator engineering and technology. Lindstrom, E.R.; Taylor, L.S. Piscataway, NJ; IEEE Service Center (1987). (CONF-870302—).

From Particle accelerator conference; Washington, DC, USA (16 Mar 1987).

A solid state image sensor called a charge coupled device, or CCD, was evaluated as a beam profile monitor for 14 GeV/amμ / sup 16/O ions and 14 GeV protons accelerated by the Alternating Gradient Synchrotron (AGS) at Brookhaven National Laboratory. The relativistic heavy ion experiment, E-802, requires tightly focussed relativistic heavy ion and proton beams from the AGS. The beam transport system designed for E-802 should provide a focal spot of 1-2 mm in size which is difficult to measure quantitatively with conventional beam diagnostic wire chambers that have 2 mm wire spacings. Since the ionization level is high because of the high Z of heavy ions, a charge coupled device (CCD) should be very responsive to minimum ionizing heavy ions and possibly to protons as well.

4304 Storage Rings

REFER ALSO TO CITATION(S) 43795

43749 **(EFI—976(26)-87) Electron beam transport channels in the ERSINEh-1.5 accelerating and storage complex.** Akopyan, V.P.; Karabekov, I.P.; Prejzendorf, V.A. (Erevanskij Fizicheskij Inst. (USSR)). 1987. 18p. (In Russian). NTIS (US Sales Only), PC A03/MF A01. Order Number DE88703491/JAW.

The results of calculations and optimization of channels for electron beam transport from a microtron to the booster and from the booster to the storage ring in the ERSINEh complex intended for a synchrotron radiation generation, are presented. A brief description and characteristics of the ERNAC program, adopted for the calculation and easy optimization of the beam transport lines in an interactive mode are given. 10 refs.; 3 figs.; 2 tabs.

43750 **(INS-T—474) Beam diagnostic instruments of TARN.** Watanabe, Shin-ichi. (Tokyo Univ., Tanashi (Japan). Inst. for Nuclear Study). Sep 1987. 28p. NTIS (US Sales Only), PC A03/MF A01. Order Number DE88753414/JAW.

The paper summarizes the beam diagnostic instruments of the low energy ion accumulation ring; TARN. With these monitors, position, profiles, bunch structure, intensity, emittance and mo-

mentum spread were measured to evaluate the injection and stacking experiments. The monitors provide the sensitivity of a few μA for the nondestructive and a few nA for the destructive monitors. Discussions on monitor probe and electronics are presented on the basis of an achievement of the beam stacking experiments.

43751 **(INS-T—475) Construction of the TOPAZ inner drift chamber.** Kono, K.; Imanishi, A.; Ishii, T. (Tokyo Univ., Tanashi (Japan). Inst. for Nuclear Study). Sep 1987. 25p. (In Japanese). NTIS (US Sales Only), PC A03/MF A01. Order Number DE88753415/JAW.

An Inner Drift Chamber (IDC) has been constructed for the TOPAZ e^+e^- experiment at TRISTAN. The IDC has a cylindrical shape with dimensions of 20 cm in inner diameter, 60 cm in outer diameter and 150 cm long. The IDC is equipped with 1024 anode wires grouped into 10 layers. For the position readout along the anode wires, eight delay-line layers are placed on coaxial cylinders made of Normex honeycomb. The chamber is operated with a gas mixture of Ar(89 %)CO_2(10 %)CH_4(1 %) at an atmospheric pressure. In this paper, details of the mechanical structure and the fabrication procedures are described.

43752 **(INS-T—476) Electronics for cathode delay-line readout of the TOPAZ inner drift chamber.** Shiino, K.; Imanishi, A.; Ishii, T.; Kono, K.; Masuda, H.; Norimura, K.; Ohshima, T.; Okuno, H.; Ukai, K. (Tokyo Univ., Tanashi (Japan). Inst. for Nuclear Study). Sep 1987. 42p. (In Japanese). NTIS (US Sales Only), PC A03/MF A01. Order Number DE88753416/JAW.

An electronics system for the cathode delay-line readout of the TOPAZ Inner Drift Chamber has been designed and fabricated. Eight layers of the shifted zig-zag delay lines with line velocities of 3 ~ 4 ns/cm have been assembled on the coaxial honeycomb cylinders of 150 cm long. A perimeter of each cylinder is covered by 32 delay lines. A total number of delay lines is 256 and that of electronics channels is 512 because signals from both ends of the delay line are used for position determination along the cylinder axis. This electronics system has been developed especially for fast triggering with this delay line information. Track finder modules can find particle tracks originating from the beam interaction point in the r-z plane with a processing time of 1.5 μsec. Accurate z coordinates are measured by use of the multi-hit pipe-line TDC. In this report, details of the electronics circuits are described.

43753 (KEK—87-20, pp 247-253) **Status of HERA and its physics.** Yamada, Sakue. (Tokyo Univ., Tanashi (Japan). Inst. for Nuclear Study). Nov 1987. NTIS (US Sales Only), PC A12/MF A01. Order Number DE88780084/JAW. (CONF-8705290—).

From Meeting on physics at TeV energy scale; Oho, Japan (28 May 1987).

The present status of HERA and detectors to be constructed are introduced. Some of the physics topics which will be investigated are described.

43754 **High rate luminosity monitors for CESR*.** Bobbink, G.J.; Brock, I.C.; Kraemer, R.W.; Sutton, R.B.; Dean, D.A.; Herb, S.W. (Physics Dept., Carnegie Mellon Univ., 5000 Forbes Avenue, Pittsburgh, PA (US)). pp 754-756 of Proceedings of the 1987 IEEE particle accelerator conference: Accelerator engineering and technology. Lindstrom, E.R.; Taylor, L.S. Piscataway, NJ; IEEE Service Center (1987). (CONF-870302—).

From Particle accelerator conference; Washington, DC, USA (16 Mar 1987).

Compact luminosity monitors using Bismuth Germanate (BGO) crystals with photodiode readout have been built and installed at the Cornell Electron Storage Ring. The counters are located 2.0 m from the interaction point, outside the inner pair of quadrupoles which are horizontally defocussing. They observe Bhabha scatters near the horizontal plane with angles between 10 and and 16 milliradians. Real coincidence rates are several hundred Hertz at 2x10/sup 31/cm/sup -2/s/sup -1/ luminosity and accidentals are reliably subtracted using a delayed coincidence technique. The Cornell Electron Storage Ring (CESR) is an e/sup +/e/sup -/ storage ring used primarily for the study of e/sup +/e/sup -/ collisions in the γ energy region (E/sub beam/ ≃ 5 GeV). With the recent addition of permanent rare earth cobalt (REC) magnet microbeta quadrupoles to the two CESR interaction regions, the angular region traditionally covered by a small angle luminosity monitor was made inaccessible as the microbeta quadrupoles have their front face only 55 cm from the interaction point. At the same time the CESR machine group made clear the need for a "luminosity signal" with a time constant appropriate for tuning, i.e. a few seconds. For example, the old CLEO detector luminosity monitor ran at scaler rates of 13 Hz at a luminosity of 10/sup 31/cm/sup -2/s/sup -1/, which implies a one minute counting time to get a statistically significant measurement.

44 INSTRUMENTATION

4401 Radiation Instrumentation

REFER ALSO TO CITATION(S) 42868, 42883, 43538, 43678, 43700, 43721, 43742, 43744, 43751, 43753, 43953, 44007, 44010, 44300

43755 **(CERN/EP—87-179) Precision measurements of masses of radioactive atoms using ISOLDE and ion traps.** Kluge, H.J. (European Organization for Nuclear Research, Geneva (Switzerland)). 30 Sep 1987. 17p. (CONF-8706176—8). NTIS (US Sales Only), PC A03; 1; GPO Dep. Order Number DE88012597/JAW.

From Workshop and symposium on the physics of low energy, stored, and trapped particles; Stockholm, Sweden (14 Jun 1987).

A mass spectrometer has been set up at the on-line isotope separator ISOLDE at CERN/Geneva. Mass-separated radioactive ions are stored in Penning trap. Their mass is determined by a measurement of the cyclotron frequency in the magnetic field of a superconducting magnet. A resolving power of up to 300 000 and a precision of some 10 keV were determined in case of mass measurements of neutron-deficient Rb and Cs isotopes. 17 refs., 5 figs.

43756 **(CERN-EP—87-195) Some applications of the imaging proportional chamber.** Charpak, G.; Dominik, W.; Fabre, J.P.; Gaudaen, J.; Peskov, V.; Sauli, F.; Suzuki, M.; Breskin, A.; Chechik, R.; Sauvage, D. (European Organization for Nuclear Research, Geneva (Switzerland)). 21 Oct 1987. 5p. (CONF-871006—52). NTIS (US Sales Only), PC A02. Order Number DE88012621/JAW.

From 34. nuclear science symposium and 19. nuclear power systems symposium; San Francisco, CA, USA (21 Oct 1987).

Photons emitted by avalanches in gases can be tested with an image intensifier coupled to a solid state camera. Some vapors enhance the emission at wavelengths close to the visible. We describe progress made in the imaging of charged particles and of Cherenkov photons. 15 refs., 11 figs.

43757 **(CRN-PN—87-04) Experimental study with Diogene of protons produced in α-nucleus reactions between 200 and 800 MeV by nucleon.** Racca, C. (Strasbourg-1 Univ., 67 (France). Centre de Recherches Nucleaires). Jan 1988. 208p. (In French). NTIS (US Sales Only), PC A10/MF A01. Order Number DE88753944/JAW.

The detection set Diogene situated on a measurement line of the Saturne accelerator allows the study of alpha-nuclei collisions among others, at relativistic energies. Such collisions between 200 and 800 MeV by nucleon are studied here. The experimental device is presented; trajectory reconstruction and identification are detailed; after some recalls on the models known at these energies and the two codes used, the data analysis with lead, copper, carbon targets is limited to protons and pseudo-protons produced in the reactions. The discussion is centered on previsions with cascades. Global variations are introduced such as conicity and forwardness.

43758 **(FNAL-TM—1523) Fast non-explosive gases for drift chambers.** Green, D.; Haggerty, H.; Oshima, N.; Yamada, R. (Fermi National Accelerator Lab., Batavia, IL (USA)). May 1988. Contract AC02-76CH03000. 10p. NTIS, PC A03/MF A01;1; GPO Dep. Order Number DE88012104/JAW.

Typical gases which are stock at Fermilab are Ar:C_2H_6(50:50) and Ar:CO_2 (80:20). Argon:Ethane has the virtue of high gas gain and a saturated drift velocity. In fact, parametrizing the drift velocity as a function of electric field we find v/sub d/(E) = v/sub o/(1{minus}e/sup -E/E/o) with v/sub o/ ≃ 5.4 cm/μsec and E/sub o/ = 160 V/cm. However, safety considerations make this gas somewhat inconvenient. The addition of alcohol as quencher also raises the saturation field to, for example, E/sub o/ ≃ 500 V/cm for 1.5% added alcohol. This gas also tends to break up in a high-beam flux environment and leave carbon deposits. The addition of alcohol to avoid such aging often takes a unit cell out of saturation over its entire volume. Finally, for collider applications it is useful to exclude free protons from the gas in order to reduce the sensitivity to the sea of slow neutrons which are present in the collider environment. In contrast, Ar:CO_2 (80:20) is a gas with more moderate gas gain. The drift velocity at high field is v/sub d/(E > 1.5 kV/cm) ≃ 5.8 cm/μsec. For most field configurations this gas does not saturate, causing a long tail in the drift time distrubtion due to low field regions in the unit cell. The virtues of this gas mixture are that it is cheap, not flammable, and stable under high-beam flux. However as the Collider Upgrade progresses, we wish to find a gas which is faster than 5.0 cm/μsec since the time separation between collisions will at some point be less than drift time of 1μsec for drift distance of 5 cm. 3 refs., 5 figs.

43759 **(IEN-DIFIS—01/84) Implantation and use of a version of the GAMALTA computer code in the 3.500 M Le Croy system.** Auler, L.T. (Instituto de Engenharia Nuclear, Rio de Janeiro (Brazil)). May 1984. 15p. (In Portuguese). NTIS (US Sales Only), PC A03/MF A01. Order Number DE88702558/JAW.

The GAMALTA computer code was implanted in the 3.500 M Le Croy system, for creating an optional analysis function which is charged in RAM memory from a discket. The mode to construct functions to make part of the menu of the system is explained and a procedure to use the GAMALTA code is done. (M.C.K.).

43760 **(INIS-mf—11210, pp VI3-VI8) Software for the TNA explosive detection system.** Gozani, T.; Shea, P.; Adir, J. (Science Applications International Corp., Sunnyvale, CA (USA)). Dec 1987. NTIS (US Sales Only), PC A13/MF A01. Order Number DE88780087/JAW. (CONF-871287—).

From Nuclear Societies of Israel annual meeting; Haifa, Israel (21 Dec 1987).

Transactions.; V. 14.

43761 **(INIS-mf—11210, pp VI9-VI13) Reconstruction of radiographic images by means of an adaptive polynom fitting.** Ingman, D.; Merlis, Y. (Technion-Israel Inst. of Tech., Haifa. Dept. of Nuclear Engineering). Dec 1987. NTIS (US Sales Only), PC A13/MF A01. Order Number DE88780087/JAW. (CONF-871287—).

From Nuclear Societies of Israel annual meeting; Haifa, Israel (21 Dec 1987).

Transactions.; V. 14.

43762 **(INIS-mf—11210, pp VI20-VI24) Reduction of blur in coplaner rotational laminagraphic images.** Cohen, B.; Segal, Y. (Technion-Israel Inst. of Tech., Haifa. Dept. of Nuclear Engineering). Dec 1987. NTIS (US Sales Only), PC A13/MF A01. Order Number DE88780087/JAW. (CONF-871287—).

From Nuclear Societies of Israel annual meeting; Haifa, Israel (21 Dec 1987).

Transactions.; V. 14.

43763 **(INIS-mf—11210, pp VI31-VI38) Single projection tomography of objects with cylindrically symmetric density distribution.** Pal, D.; Notea, A.; Deutsch, M. (Technion-Israel Inst. of Tech., Haifa. Dept. of Nuclear Engineering; Bar-Ilan Univ., Ramat-Gan (Israel). Dept. of Physics). Dec 1987. NTIS (US Sales Only), PC A13/MF A01. Order Number DE88780087/JAW. (CONF-871287—).

From Nuclear Societies of Israel annual meeting; Haifa, Israel (21 Dec 1987).

Transactions.; V. 14.

43764 **(INIS-mf—11210, pp VI39-VI42) Solution of the inverse problem in radiographic interpretation by theoretical model and convolutable function.** Bushlin, Y.; Notea, A. (Technion-Israel Inst. of Tech., Haifa. Dept. of Nuclear Engineering). Dec 1987. NTIS (US Sales Only), PC A13/MF A01. Order Number DE88780087/JAW. (CONF-871287—).

From Nuclear Societies of Israel annual meeting; Haifa, Israel (21 Dec 1987).

Transactions.; V. 14.

43765 **(INIS-mf—11210, pp VI43-VI49) Dual energy approach for mass and elemental composition distributions in ceramics.** Trichter, F.; Notea, A. (Technion-Israel Inst. of Tech., Haifa. Dept. of Nuclear Engineering). Dec 1987. NTIS (US Sales Only), PC A13/MF A01. Order Number DE88780087/JAW. (CONF-871287—).

From Nuclear Societies of Israel annual meeting; Haifa, Israel (21 Dec 1987).

Transactions.; V. 14.

43766 (INIS-mf—11210, pp VII10-VII13) **Alpha-beta-gamma scintillation spectrometer and the measurement of H-3/I-125 and C-14/I-125 samples.** Kalish, Y. (Beilinson Medical Center, Petah Tiqua (Israel). Dept. of Medical Physics). Dec 1987. NTIS (US Sales Only), PC A13/MF A01. Order Number DE88780087/JAW. (CONF-871287—).

From Nuclear Societies of Israel annual meeting; Haifa, Israel (21 Dec 1987).

Transactions.; V. 14.

43767 **(ITEF—167(1987)) Emission detector with 8l liquid krypton volume with diameter 41 and length 55 cm/sup 3/ as operating medium.** Anisimov, S.N.; Barabash, A.S.; Bolozdynya, A.I.; Stekhanov, V.N. (Gosudarstvennyj Komitet po Ispol'zovaniyu Atomnoj Ehnergii SSSR, Moscow. Inst. Teoreticheskoj i Ehksperimental'noj Fiziki). 1987. 12p. (In Russian). NTIS (US Sales Only), PC A03/MF A01. Order Number DE88703603/JAW.

The emission detector with 8 liters liquid krypton as operating medium has been developed. It is shown that a natural impurity of radioisotopes may be used as an intrinsic ionization source to study characteristics of detector operating medium, for example to control medium purity. It has been estimated that molar concentration of /sup 85/Kr isotopes is 8.9x10/sup -12/. 4 refs.; 4 figs.

43768 **(ITEF—178(1987)) Data readout system for multiwire proportional chambers.** Men'shchikov, R.A.; Nedosekin, A.A.; Rozhkov, A.B. (Gosudarstvennyj Komitet po Ispol'zovaniyu Atomnoj Ehnergii SSSR, Moscow. Inst. Teoreticheskoj i Ehksperimental'noj Fiziki). 1987. 20p. (In Russian). NTIS (US Sales Only), PC A03/MF A01. Order Number DE88703607/JAW.

An electronic system for data readout from multiwire proportional chambers is described. The system will be used in a magnetic spectrometer for investigation into rare processes in an ITEP accelerating complex. Schematic solutions, used in the system allow one to maximally use the 'VECTOR' standard interface fast operation. The system assembly is completely made of domestic parts. The readout system structure developed allows one to easily reduce or increase the number of MPC channels questioned. The mean time, required for preparing data on cluster, does not exceed 1.5 μs. 9 refs.; 9 figs.

43769 (JINR—13-87-496) Bipolarity voltage adapter for a 6V power supply. Zyazyulya, F.E.; Moiseenko, A.S. (AN Belorusskoj SSR, Minsk. Inst. Fiziki). (Joint Inst. for Nuclear Research, Dubna (USSR). Lab. of Nuclear Problems). 1987. 4p. (In Russian). NTIS (US Sales Only), PC A02/MF A01. Order Number DE88703657/JAW.

The structure of recording system used in the ARES spectrometer is considered. It includes about 15000 signal electronic channels located in 15 special crates and powered by the voltage of (+3 V, -3 V). The drain currents are nonsymmetric and equal (36 A and 32.5 A) on each crate. The adapter has been developed for available working of power supply. It is a parallel voltage stabilizer and is fed parallel to negative output pemitting to obtain dual parity voltage on load arms by aligning power currents from one power supply. The current range is from 0.05 A to 5 A. The adapter is successfully employed for many yeras. 6 refs.; 5 figs.

43770 (JINR—13-87-628) Multifunctional coder of detector number. Zhironkin, G.F.; Oganezov, G.A. (Joint Inst. for Nuclear Research, Dubna (USSR). Lab. of Neutron Physics; AN Gruzinskoj SSR, Tbilisi. Inst. Fiziki). (Joint Inst. for Nuclear Research, Dubna (USSR). Lab. of Neutron Physics). 1987. 2p. (In Russian). NTIS (US Sales Only), PC A02/MF A01. Order Number DE88703663/JAW.

Submitted to the journal Instrum. Exp. Tech. .

The CDN-32 detector number coder used in the measuring module of time-of-flight spectrometer of cold neutrons is described. The coder may be used for conversion of detector number into binary-coded decimal. The unit provides for the multidimensional regime of registrating of neutron spectra. It could operate simultaneously with a multichannel analyser of microcomputer. The unit was performed in the CAMAC standard. 1 ref.; 1 fig.

43771 (JINR—13-87-714) Converters in the streamer chamber of the RISK magnetic spectrometer. Bannikov, A.V.; Behm, Ya.; Vertogradov, L.S. and others. (Joint Inst. for Nuclear Research, Dubna (USSR). Lab. of Nuclear Problems). 1987. 6p. (In Russian). NTIS (US Sales Only), PC A02/MF A01. Order Number DE88703667/JAW.

Submitted to the journal Instrum. Exp. Tech. .

A set of gamma-converters made of lead glass TF5 was used in the experiments on the study of exclusive processes of production of J/psi particles and direct muon pairs in π/sup -/C interactions, as well as of particles with a high transversal momentum in π/sup -/(p, d, C, Cu, Pb) interactions at 38 GeV in the streamer chamber. Design of converters and method for using them in the streamer chamber are described. The momentum and angular spectra of γ-quanta were measured for the first time using such a method. 10 refs.; 6 figs.

43772 (JINR—13-87-764) Working gas leakage detector for proportional chambers of the ARES facility. Vanko, J.; Kravchuk, N.P.; Moiseenko, A.S.; Filippov, A.I. (Joint Inst. for Nuclear Research, Dubna (USSR). Lab. of Nuclear Problems). 1987. 5p. (In Russian). NTIS (US Sales Only), PC A02/MF A01. Order Number DE88703668/JAW.

A detector of the working gas mixture leakage from the cylindrical multiwire proportional chambers of the ARES facility has been developed and built. It produces an alarm signal, when the isobutane content in the air surrounding the chambers exceeds 1%. This air is continuously blown through the small multiwire chamber that is the main part of the apparatus. The device has been reliably and stably employed for a long time. 4 refs.; 7 figs.

43773 (JINR—13-87-773) High voltage pulse system for the streamer chamber supply of the GIBS spectrometer. Aksinenko, V.D.; Glagoleva, N.S.; Dement'ev, E.A.; Kaminskij, N.I.; Matyushin, A.T.; Matyushin, V.T.; Rozhnyatovskaya, S.A.; Ryakhovskij, V.N.; Nurgozhin, N.N.; Khusainov, E.K. (Joint Inst. for Nuclear Research, Dubna (USSR). Lab. of High Energy; AN Kazakhskoj SSR, Alma-Ata. Inst. Fiziki Vysokikh Ehnergij). (Joint Inst. for Nuclear Research, Dubna (USSR). Lab. of High Energy). 1987. 8p. (In Russian). NTIS (US Sales Only), PC A02/MF A01. Order Number DE88703669/JAW.

Results of development and testing of high voltage pulse system HVPS for the streamer chamber supply of the GIBS spectrometer are presented. HVPS consists of the following basic blocks: nanosecond pulse high voltage generator, high voltage charging supply, trigger generator, chamber parameter control devices, gas-oil vacuuming supply systems, auxiliary and fire-prevention devices. The system blocks are described. Experimental results of HVPC testing are presented. HVPC provides a reliable (10/sup 5/ operations) of streamer chamber supply with high voltage pulse parameters: amplitude - 500 kV, amplitude instability (0.5-1.5)%, pulse duration - 12 ns, delay time - 500 ns, delay instability (2.5-5)%, mean frequency of output a signals - 0.1 Hz. 7 refs.; 5 figs.; 1 tab.

43774 (JINR—13-87-818) Dielectric parameters and electric field forming in electrodeless drift chambers. Artykov, A.M.; Glagolev, V.V.; Glinka, V.; Kladiva, Eh.; Sitar, B. (Tashkentskij Gosudarstvennyj Univ. (USSR)). (Joint Inst. for Nuclear Research, Dubna (USSR). Lab. of Nuclear Problems). 1987. 8p. (In Russian). NTIS (US Sales Only), PC A02/MF A01. Order Number DE88703671/JAW.

Submitted to the journal Instrum. Exp. Tech. .

The results of the measurements of dielectric material parameters for electrodeless drift chambers (DC) are given. The influence of resistivity of material on dynamic processes of electric field forming inside the electrodless DC under conditions of different particle flux is discussed. The characteristics of several electrodless DCs are compared. 7 refs.; 6 figs.; 1 tab.

43775 (JINR-E—13-87-292) Dirac delta-plus (or minus) function in optics and mesooptics. Soroko, L.M. (Joint Inst. for Nuclear Research, Dubna (USSR). Lab. of Nuclear Problems). 1987. 12p. NTIS (US Sales Only), PC A03/MF A01. Order Number DE88703699/JAW.

The topic of this article is Dirac delta-plus function and its application in Hilbert optics and mesooptics. The article begins with the introduction of the backgrounds and of the underlying relations. Then the properties of the coherent imaging system containing various spatial frequency filters are treated. The analysis of mesooptical imaging system used for observation of the straight line particle tracks in the nuclear emulsion is presented. It is shown that in a general case the convolution kernel of mesooptical system is a superposition of the form a/sub 1/δ/sub +/(x)+a/sub 2/ x (d/dx)δ/sub +/ (x). 17 refs.; 5 figs.

43776 (JINR-E—13-87-607) Investigation of the operational stability of plastic streamer tubes after polishing of their graphite cathode. Alekseev, G.D.; Cellar, S.; Baroncelli, A. and others. (Joint Inst. for Nuclear Research, Dubna (USSR). Lab. of Nuclear Problems; Istituto Nazionale di Fisica Nucleare, Rome (Italy); Istituto Superiore di Sanita, Rome (Italy)). (Joint Inst. for Nuclear Research, Dubna (USSR). Lab. of Nuclear Problems). 1987. 6p. NTIS (US Sales Only), PC A02/MF A01. Order Number DE88703700/JAW.

Submitted to the journal Lett. to NIM.

Investigation of plastic streamer tube stability after mechanical polishing of their graphite cathode is carried out. The method of checking the efficiency of polishing is as follows. "Bad" points are found by scanning a β-source along the unpolished detectors. Then the tubes are disassemblied and regions of "bad" points are polished. The surface resistivity decreased in average by a factor 1.5 - 4 and became 50-300 k Ohm for profiles. After the assembling of the detectors there is only one "bad" point from 10 "bad" points found initially. It is shown that the polishing of the graphite cathodes of plastic streamer tubes increases their operational stability. 9 refs.; 4 figs.

43777 (JINR-R—1-87-429) Modelling of the geometric efficiency of cumulative hadron spectrometer (SKA setup). Estimation of the role of geometric factors and background processes. Belyaev, I.M.; Frolov, S.V.; Gavrishchuk, O.P.; Zolin, L.S.; Peresedov, V.F. (Gosudarstvennyj Komitet po Ispol'zovaniyu Atomnoj Ehnergii SSSR, Moscow. Inst. Teoreticheskoj i Ehksperimental'noj Fiziki). (Joint Inst. for Nuclear Research, Dubna (USSR). Lab. of High Energy). 1987. 12p. (In Russian). NTIS (US Sales Only), PC A03/MF A01. Order Number DE88703713/JAW.

The calculation algorithm of the geometric efficiency of cumulative hadron spectrometer is described. This algorithm is based on the method of mathematical simulation of the passage of investigated particles through the spectrometer. A comparison of the experimental and simulated distributions shows their good agreement. The processing of generated events with the imitation of background distorsions by the data processing program makes it possible to estimate the efficiency of the criterion of background suppression. 5 refs.; 14 figs.

43778 (JINR-R—1-87-591) Experimental installation Scintillation magnetic spectrometer (SMS-MSU). Bel'zer, L.I.; Bodyagin, V.A.; Vardanyan, I.N. and others. (Moskovskij Gosudarstvennyj Univ. (USSR). Nauchno-Issledovatel'skij Inst. Yadernoj Fiziki). (Joint Inst. for Nuclear Research, Dubna (USSR). Lab. of High Energy). 1987. 37p. (In Russian). NTIS (US Sales Only), PC A03/MF A01. Order Number DE88703717/JAW.

SMS-MSU - a single arm magnetic spectrometer with changeable geometry - has been put into operation at JINR accelerator. The basic elements of the apparatus are: a multichannel scintillation hodoscope having coordinate resolution ~ 1 mm; and an array of scintillation and Cherenkov detectors which implements the selection, ta trigger level, of events with present kinematics. The physical program of the experiment focuses on the features of hadron fragmentation and absorption on a subnuclear scale, where the observable effects would very likely bear an immediate impress of quark hadronization pattern. The specific aspects of the experimental approach to the problem are considered, and some details on the design and technical realization of the experiment are presented. 34 refs.; 2 figs.; 1 tab.

43779 (JINR-R—1-87-853) Reconstruction of electron and gamma-quantum energy in total absorption gamma spectrometer. Abraamyan, Kh.U.; Khudaverdyan, A.G.; Astvatsaturov, R.G.; Khachaturyan, M.N. (Erevanskij Gosudarstvennyj Univ. (USSR)). (Joint Inst. for Nuclear Research, Dubna (USSR). Lab. of High Energy). 1987. 10p. (In Russian). NTIS (US Sales Only), PC A02/MF A01. Order Number DE88703723/JAW.

Submitted to the journal Instrum. Exp. Tech. .

The formula allowing one to calculate energy losses in the matter, placed in front of a total absorption γ-spectrometer, in the measurement of electron and γ-quantum energies, has been derived. The formula also takes into account nonlinearity of the γ-spectrometer to low-energy electrons and γ-quanta. 9 refs.; 3 figs.; 2 tabs.

43780 (JINR-R—10-87-691) Modular system for spectroscopic data acquisition. Multi-channel analyzer. Boja, Ya.; Vagov, V.A.; Zhukov, G.P.; Rubin, D.; Kharangozo, Zh. (Joint Inst. for Nuclear Research, Dubna (USSR). Lab. of Neutron Physics). 1987. 19p. (In Russian). NTIS (US Sales Only), PC A03/MF A01. Order Number DE88703768/JAW.

A Multichannel Analyser of the CAMAC data acquisition system having modular architecture is described. It is intended for experimental data processing: receiving analysing and storing. The system provides setting of: 4K volume memory address field; offset of memory working field: address and data overflow test; word length of memory 12/24 bit; data block and word transmission in programmable way. The maximum memory capacity of the analyser is 32Kx24 bit and the memory cycle time is at least 2μs. 3 refs.; 5 figs.

43781 (JINR-R—13-87-474) Simulation of direct technique for registration of stars in nuclear emulsion by means of the kinoform with a ring response. Bencze, Gy.L.; Soroko, L.M.; Pal'chikova, I.G.; Poleshchuk, A.G. (Joint Inst. for Nuclear Research, Dubna (USSR). Lab. of Nuclear Problems; AN SSSR, Novosibirsk. Inst. Avtomatiki i Ehlektrometrii). (Joint Inst. for Nuclear Research, Dubna (USSR). Lab. of Nuclear Problems). 1987. 12p. (In Russian). NTIS (US Sales Only), PC A03/MF A01. Order Number DE88703776/JAW.

The direct technique for registration of stars in nuclear emulsion was experimentally simulated by means of the Mesooptical Fourier Transform Microsope (MFTM) involving the kinoform with a ring response and the system of concentric transparent rings. The effects induced by the mismatching of the star vertex with the centre of the system of concentric transparent rings are investigated. The error with which the coordinates of the star vertex can be estimated is evaluated. The calculated performances of the real system of direct star registration in nuclear emulsion by means of the MFTM with mesooptical element numerical aperture of 0.53 are given. 10 refs.; 11 figs.

43782 (JINR-R—13-87-760) Fobos- a 4π - spectrometer for multiple products of heavy ion reactions. Akhperdzhanyan, A.G.; Burova, B.A.; Walzog, D. and others. (Erevanskij Fizicheskij Inst. (USSR); Bylgarska Akademiya na Naukite, Sofia. Edinen Tsentyr po Fizika; Zentralinstitut fuer Kernforschung, Rossendorf bei Dresden (German Democratic Republic)). (Joint Inst. for Nuclear Research, Dubna (USSR). Lab. of Nuclear Reactions). 1987. 12p. (In Russian). NTIS (US Sales Only), PC A03/MF A01. Order Number DE88703777/JAW.

A 4π-spectrometer for multiple products of heavy ion reactions in the energy range from 15 to 120 MeV/nucleon is described. The 4π-spectrometer FOBOS consists of 30 autonomous detector modules placed around the target at a distance of 0.5 m. The detector modules have the form of the frusta of circular base cones. Each of the 30 detector modules consists of a position-sensitive avalanche counter, a Bragg ionization chamber and a ΔE-E scintillation telescopes. The dynamic energy range of the detected products lies between 1 and 10/sup 6/. 40 refs.; 9 figs.; 1 tab.

43783 (JINR-R—14-87-592) Use of 123 keV γ-radiation for investigation of substance near the critical point. Experimental apparatus. Osipenko, B.P.; Simkina, A.P.; Tishin, V.G. (Joint Inst. for Nuclear Research, Dubna (USSR). Lab. of Neutron Physics). 1987. 10p. (In Russian). NTIS (US Sales Only), PC A02/MF A01. Order Number DE88703781/JAW.

Experimental apparatus for investigation of substance near the critical point by transmission of γ-rays with 123 keV energy has been designed and tested. The apparatus works within the 285-340 K temperature range, with the approach to critical temperature up to r=10/sup -4/-10/sup -5/ (r=(T/sub K/-T)/T/sub K/). Sample temperature instability is not higher than 0.0001 K. The accuracy of determining the meniscus position is not worse than 0.1 mm. The energy resolution of detector and detecting channel is 3.5 keV. It is shown on xenon sample that the accuracy of determining the density of liquid and vapour in meniscus is 0.07% and 0.01, respectively. Using this apparatus substances could be investigated, whose element serial numbers are higher than 40. The apparatus permits to study the coexistence curve, critical isotherm, compressibility, temperature dependence of motion of frontier liquid-vapour. The coexistence curve of mixture, if as an admixture a radioactive isotope is taken, for example, J or Kr, could also be determined. 12 refs.; 8 figs.

43784 (JINR-R—15-87-641) Methodical peculiarities of the experiment on the search for the monopole nuclear excitation when muon stopping in /sup 152/Sm target. Sabirov, B.M.; Abazov, V.M.; Vagner, V. and others. (Joint Inst. for Nuclear Research, Dubna (USSR). Lab. of Nuclear Problems). 1987. 11p. (In Russian). NTIS (US Sales Only), PC A03/MF A01. Order Number DE88703784/JAW.

Submitted to 2. International symposium Mesons in matter, Dubna, Jun - Jul 1987.

The paper describes a facility MEGA designed for the search of the monopole excitation of the /sup 152/Sm nucleus at the bound muon decay μ/sup -/ -> e/sup -/ + ν/sub μ/ + ν/sub e/ in the K-orbit of the mesic atom. The facility consisting of a telescope of scintillation counters and a Ge(Li)-detector allows detection of γ-e coincidences correlated with the muon stop in a target of enriched /sup 152/Sm. Measurements at the muon beam of the synchrotron showed that the time resolution of the facility is < 5 ns, and the effect-to-background ratio is approximately 1.5. The report describes operation of the electronics on line with the computer SM-3 and the software for the experiment which allows performing measurements, sorting and tentatively processing the events during the experiment. 12 refs.; 8 figs.

43785 (KEK—87-20, pp 154-159) **Solar neutrino detection by the scintillator ball.** Chiba, Masami. (Tokyo Metropolitan Univ. (Japan)). Nov 1987. NTIS (US Sales Only), PC A12/MF A01. Order Number DE88780084/JAW. (CONF-8705290—).

From Meeting on physics at TeV energy scale; Oho, Japan (28 May 1987).

Davis et al. detected solar neutrinos from the decay of ^{8}B. The flux was under one third of the standard solar model prediction. Recently people propose that the deficiency is caused by neutrino oscillation in matter or in vacuum between the sun and the earth. The rate of the deficiency is very sensitive in mass differences and mixing angles among the neutrino species. Investigation of the solar neutrino seems to be the best way to entangle the neutrino mass problem which is one of the most important issue in elementary particle physics.

43786 (KEK—87-20, pp 180-185) **Dark matter and cryogenic methods for its detection.** Watanabe, Tadashi; Ebisu, Takeo. (Kobe Univ. (Japan). Dept. of Physics). Nov 1987. NTIS (US Sales Only), PC A12/MF A01. Order Number DE88780084/JAW. (CONF-8705290—).

From Meeting on physics at TeV energy scale; Oho, Japan (28 May 1987).

We describe why the dark matter is required to exist, and give a brief review about cryogenic techniques effective to detect weakly interacting particles with the status of our study on superheated superconducting granules included.

43787 (KEK—87-20, pp 218-223) **First result from AMY experiment.** Sagawa, H. (National Lab. for High Energy Physics, Oho, Ibaraki (Japan)). Nov 1987. NTIS (US Sales Only), PC A12/MF A01. Order Number DE88780084/JAW. (CONF-8705290—).

From Meeting on physics at TeV energy scale; Oho, Japan (28 May 1987).

Electron-positron reactions have been observed in the AMY detector at 50 GeV center of mass energy at the Tristan storage ring during Jan-Feb run in 1987. AMY detector observed eight hadronic events and some electroweak interactions for 53 nb^{-1} integrated luminosity. Here preliminary results are reported.

43788 (KEK—87-20, pp 224-231) **TOPAZ experiment.** Uno, S. (Nagoya Univ. (Japan). Dept. of Physics). Nov 1987. NTIS (US Sales Only), PC A12/MF A01. Order Number DE88780084/JAW. (CONF-8705290—).

From Meeting on physics at TeV energy scale; Oho, Japan (28 May 1987).

The TOPAZ Detector is a general purpose detector characterized by a good capability to identify particles. From the first beam run, all the detector components have been working without any serious problem. From the data in the first data taking cycle, we obtained a clean Bhabha event sample whose angular distribution is consistent with QED prediction.

43789 (KEK—87-20, pp 232-246) **Status of CDF experiment in 1987.** Miyashita, S. (Tsukuba Univ., Sakura, Ibaraki (Japan)). Nov 1987. NTIS (US Sales Only), PC A12/MF A01. Order Number DE88780084/JAW. (CONF-8705290—).

From Meeting on physics at TeV energy scale; Oho, Japan (28 May 1987).

CDF accumulated a significant amount of data for the first time in the early months of 1987. The integrated luminosity used for data taking reached 34 inverse nano-barns by the time the Tevatron terminated its collider-mode operation on May 11. Early examination of the data indicates a rich concentration of W and Z events as well as high transverse-momentum jets.

43790 (LA—11237-MS) **Wire chamber assembly techniques.** MacArthur, D.W.; Adrian, S.D.; Matthews, S.K. (Los Alamos National Lab., NM (USA)). Aug 1988. Contract W-7405-ENG-36. 12p. NTIS, PC A03/MF A01; 1; GPO Dep. Order Number DE88012429/JAW.

The authors detail a series of successful techniques and methods used to assemble wire chambers for a neutron detector based on multiwire proportional chambers (MWPCs), developed by the Advanced Nuclear Technology Group, N-2. Although these techniques were developed for the N-2 chambers, many of them are applicable to other wire chamber designs as well.

43791 (LBL—22778) **Proceedings of the workshop on new solid state devices for high energy physics.** (Lawrence Berkeley Lab., CA (USA)). Dec 1987. Contract AC03-76SF00098. 129p. (CONF-8510364—). NTIS, PC A07. Order Number DE88008388/JAW.

From Workshop on new solid-state devices for high energy physics; Berkeley, CA, USA (28 Oct 1985).

This paper contains articles on semiconductor devices used in the detection of high energy particles. Some articles reported: Position sensitive semiconductor devices; Scintillation techniques and optical devices; Radiation damage to detectors; VLSI for physics; and experience with Si detectors in NA32. (LSP)

43792 (POEF-T—3476) **Instrumentation Technical Program Management Team: FY-1987 annual report.** Hanson, M.L.; Englert, G.L.; Grametbauer, G.L. (Portsmouth Gaseous Diffusion Plant, OH (USA); Paducah Gaseous Diffusion Plant, KY (USA); Oak Ridge Gaseous Diffusion Plant, TN (USA)). 14 Apr 1988. Contract AC05-76OR00001. 23p. NTIS, PC A03/MF A01; 1; GPO Dep. Order Number DE88013523/JAW.

This report contains evaluations of process, environmental, health, and safety instrumentation of gaseous diffusion plants. The study was conducted by the instrumentation technical program management team. (LSP)

43793 (SAND—88-0119) **Development of an automated x-ray gauge for nondestructive quantitative analysis.** Drotning, W.D. (Sandia National Labs., Albuquerque, NM (USA)). Mar 1988. Contract AC04-76DP00789. 56p. NTIS, PC A04/MF A01;1; GPO Dep. Order Number DE88008633/JAW.

This report describes an x-ray gauging system developed in the Materials Characterization Department at Sandia for nondestructive quantitative analysis. The automated device utilizes the transmission of low-energy x-rays through a material in order to measure the areal density of the material. If the material density is known, the x-ray gauge serves as a non-contacting thickness gauge, typically for micron-range dimensions. On the other hand, if the material thickness is known, x-ray gauging measurements yield the volume density of the material, so that quantitative chemical analysis may be achieved. Under some conditions, one material may be examined in the presence of another, making the gauge useful for examination of a thin coating on a substrate or of an element dispersed in a host matrix. Using digital rather than analog conversion techniques, measurement precision of 0.1% and accuracy near 0.5% have been achieved, with analytical correction for x-ray detection losses. The accuracy of the instrument has been demonstrated by comparison with chemical quantitative analysis techniques. Compared to chemical techniques, the x-ray gauge is faster, lower cost and nondestructive while maintaining measurement accuracy. In addition, accuracy has been demonstrated in analysis for elements for which calibration standards were not available. This feature offers a significant advantage over chemical analysis methods

which require a known calibration standard for each element to be measured. The x-ray gauge thus provides a technique for rapid, accurate and automated nondestructive quantitative analysis of materials with minimal operator attention and sample handling.

43794 **Use of low-background germanium detectors to preselect high-radiopurity materials intended for constructing advanced ultralow-level detectors.** Arthur, R.J.; Reeves, J.H.; Miley, H.S. (Pacific Northwest Lab., Richland, WA (US)). *IEEE (Institute of Electrical and Electronics Engineers) Transactions on Nuclear Science;* **35**: No. 1, 582-585(Feb 1988). (CONF-871006—).

From 34. nuclear science symposium and 19. nuclear power systems symposium; San Francisco, CA, USA (21 Oct 1987).

Measurements using a highly sensitive multi-dimensional counting system were made on commercially available components to identify materials of high radiopurity. Currently, three germanium spectrometer systems of unusually low background have been constructed using these components. Additional measures employed to achieve a low system background are: 1) carefully selecting shielding materials; 2) locating the detector underground and/or using an active external anticosmic shield to reduce the background continuum due to cosmic-particle interactions within the detector, the passive bulk shielding, and the sample mass; 3) using a special solder composition; 4) shieldilng the preamplifier electronics from the diode; and 5) exhausting nitrogen from the cryogenic dewar into the nearly airtight sample chamber to minimize the infusion of ubiquitous radon decay nuclei. One use of low-level detectors is to identify more accurately system-component radiopurity for use in the construction of advanced ultralow-level detectors. The use of a well-type spectrometer would facilitate non-destructive measurements performed on small components not available in large quantities (modified field-effect transistors, etc.) while still allowing the system to be useful for bulk samples. A carefully designed low-level gamma-ray counting system will have a system background, relative to other typical low-background systems, lower by a factor of ten or more below one MeV and by a factor of forty or more at higher energies. Such germanium-diode gamma-ray spectrometers may be constructed for a modest investment above that required for a conventional germanium detector.

43795 **Readout and trigger electronics for the TPC vertex chamber.** Ronan, M.T.; Jared, R.C.; McGathen, T.K.; Eisner, A.M.; Broeder, W.J.; Godfrey, G.L. (Lawrence Berkeley Lab., Berkeley, CA (US)). *IEEE (Institute of Electrical and Electronics Engineers) Transactions on Nuclear Science;* **35**: No. 1, 329-333(Feb 1988). (CONF-871006—).

From 34. nuclear science symposium and 19. nuclear power systems symposium; San Francisco, CA, USA (21 Oct 1987).

The TPC/Two-Gamma facility has been upgraded with a Straw Vertex Chamber for high-luminosity running of the PEP storage ring at SLAC. The high accuracy position resolution of the vertex chamber, measured to within about 4 cm of the beam vertex, will provide an impact parameter resolution of less than 90 microns for tracks with momenta greater than 1 GeV/c. When used in conjunction with the Time Projection Chamber, the vertex chamber will allow reconstruction of B meson decay vertices for B lifetime measurements, and tagging of B - B-bar events for studying mixing and other properties of b quark systems. In addition, the reconstruction of K/sub S//sup 0/ mesons will be improved. In this paper, the authors describe the readout and trigger electronics systems which have been built to satisfy the requirements.

4402 Radiation Effects On Instrument Components, Instruments, Or Electronic Systems

REFER ALSO TO CITATION(S) 43099, 43100, 44316

43796 **(UCID—21430) A method for estimating the susceptibility of electronic systems to HPM.** Mensing, R.W.; King, R.J.; Cabayan, H.S. (Lawrence Livermore National Lab., CA (USA)). May 1988. Contract W-7405-ENG-48. 69p. NTIS, PC A04/MF A01;1; GPO Dep. Order Number DE88012246/JAW.

In this report, a method for estimating the susceptibility of electronic systems to High Power Microwave (HPM) is advanced. This method is being incorporated into an overall DOD assessment methodology that is being prepared by a tri-service working group headed by the Air Force. In the next two years, the methodology will be applied to assess several military systems and modified as necessary to establish a nationally-approved standard methodology. The objective of the effort is to establish a standardized assessment methodology to guide all ongoing US HPM system effects assessment activities. The work will involve development of a detailed, integrated assessment plan that includes system functional analyses (i.e., system analyses and including all analytical modeling of HPM coupling and subsystem/component susceptibility), low power characterization test, (i.e., coupling/subsystem component tests and system functional response tests), HPM effects tests, and post-test analyses combining system functional analyses, low power characterization test, and methods for extrapolating test results to possible threat parameter regimes not readily simulated. 25 refs., 10 figs., 2 tabs.

43797 **Retention characteristics of SNOS nonvolatile devices in a radiation environment.** McWhorter, P.J.; Miller, S.L.; Dellin, T.A.; Axness, C.A. (Sandia National Labs., P.O. Box 5800, Albuquerque, NM (US)). *IEEE (Institute of Electrical and Electronics Engineers) Transactions on Nuclear Science;* **NS-34**: No. 6, 1652-1657(Dec 1987). (CONF-8707112—).

From Annual conference on nuclear and space radiation effects; Snowmass Village, CO, USA (28 Jul 1987).

A quantitative model is developed that can accurately predict the threshold voltage shift, and hence data loss, in SNOS nonvolatile memory transistors over a wide range of dose rates. The model accounts for both the time dependent and radiation induced mechanisms leading to data loss. Experimental measurements are made to verify the validity and accuracy of the model under a variety of irradiation conditions.

4403 Miscellaneous Instruments

REFER ALSO TO CITATION(S) 42731, 43669, 43676, 43682

43798 **(GEPP-TIS—1083) Coupling of a spark source mass spectrograph and a ND-YAG Laser.** Bonham, R.W.; Quattlebaum, J.C. (General Electric Co., Largo, FL (USA). Neutron Devices Dept.). 15 Jun 1988. Contract AC04-76DP00656. 15p. NTIS, PC A03/MF A01;1; GPO Dep. Order Number DE88012116/JAW.

Spark source mass spectrograph (SSMS) has been used for many years for routine semi-quantitative analysis of metals to the ppB level. GR Neutron Devices (GEND) has added a laser to their spark source instrument, and a variety of both standard and unknown metals and insulators were analyzed to demonstrate the applicability and validity of the technique. The modifications made to the standard instrument, the necessary changes made in the operating technique, and the advantages which resulted are discussed in this report. The ability to simultaneously analyze all elements, from lithium through uranium, from 100% to the ppB range in any insulating matrix does not affect the ability of the instrument to function in the spark mode. This modification should prove useful to those interested in the analysis of insulators down to the trace level without a solution step or pretreatment. Data are given for materials ranging from National Bureau of Standards (NBS) glass standards to samples in which both the matrix and the impurities are unknown. Gold, aluminum, copper, titanium, and erbium metal, as well as several different types of glasses, silica, alumina, boron nitride, and diamond, have been analyzed.

43799 **(JINR—13-87-582) KP-16K FIFO buffer memory with capacity of 16K words 16 bits each.** Gridnev, G.F.; Semenov, Yu.B.; Smirnov, V.I.; Chelnokov, L.P. (Joint Inst. for Nuclear Research, Dubna (USSR). Lab. of Nuclear Reactions). 1987. 5p. (In Russian). NTIS (US Sales Only), PC A02/MF A01. Order Number DE88703661/JAW.

A unit of the FIFO type buffer memory (capacity of 16K words, 16 bits each) of a wide application is described. It is designed in CAMAC module 2M wide. The data is written and read independently across the connectors on a face panel via the proto-

col of asynchronous transfer. Two regimes are realized in read and write cycles - the regime of alignment and that of packeting by 4K words. 5 refs.; 3 figs.

43800 **(JINR—13-87-603) Magnetometer on the base of a hermetically-sealed magnetic reed relay.** Datskov, V.I.; Drobin, V.M.; Lobotka, P. (Joint Inst. for Nuclear Research, Dubna (USSR). Lab. of High Energy). 1987. 6p. (In Russian). NTIS (US Sales Only), PC A02/MF A01. Order Number DE88703662/JAW.

Submitted to the journal Instrum. Exp. Tech. .

A magnetometer for measurement of stationary magnetic field within 0.02 - 2.0 mT range with +- 2 x 10/sup -3/ mT accuracy is described. The measuring rate depends on contact type. The mechanical hysteresis of a sensor in overwhelmed by demagnetization pulse in each measuring cycle, which allows to expand the range. Cycle duration is about 0.5 s. The magnetometer is suitable to map a magnetic field in a relatively large magnetic apparatus. 2 refs.; 3 figs.

43801 **(JINR—13-87-682) Turi device for radioactive source transport in the MUK device.** Adam, I.; Gonusek, M.; Venos, D.; Morozov, V.A.; Prazhak, F.; Chaloun, P.; Foret, I. (Ceskoslovenska Akademie Ved, Rez. Ustav Jaderne Fyziky; Joint Inst. for Nuclear Research, Dubna (USSR). Lab. of Nuclear Problems; Ustav Jaderneho Vyzkumu CSKAE, Rez (Czechoslovakia)). (Joint Inst. for Nuclear Research, Dubna (USSR). Lab. of Nuclear Problems). 1987. 5p. (In Russian). NTIS (US Sales Only), PC A02/MF A01. Order Number DE88703665/JAW.

The TURI radioactive source transport device for on-line studies with a mass spectrometer in a proton beam is described. This device is a part of the multidetector MUK-device the aim of which is the measurement of the angular correlations and lifetimes observed in radioactive decay of short-lived nuclei (T/sub 1/2/ >0.1 s). The TURY system ensures the velocity of the radioactive target movement 1 cm per 0.25 s, and microcomputer control of experiment the accuracy of the tape stop is 0.15 mm. 9 refs.; 2 figs.

43802 **(JINR-R—9-87-874) Use of inverse-magnetron system for designing a vacuum pump.** Antropov, V.K.; Mazhulin, A.V.; Derendyaev, Yu.S. (Joint Inst. for Nuclear Research, Dubna (USSR)). 1987. 6p. (In Russian). NTIS (US Sales Only), PC A02/MF A01. Order Number DE88703762/JAW.

Submitted to the Organizing Committee of 9th conference High vacuum, boundary surfaces/thin films, Dresden, 1988 Feb. .

A magnetic-discharge pump with an electrode system of inverse-magnetron type has been designed. Instead of a common honeycombed anode the use was made of anodes having the shape of rods going through orifices in titanium cathodes. Results of calculating the electrode systems having different distances between anodes point to a possibility to differentiate between the regions on the cathode surfaces to sprayed and those covered with dust. Bench tests have demonstrated the pump applicability to produce vacuum not worse than 6x10/sup -9/ Torr. 3 refs.; 10 figs.

43803 **(JINR-R—10-87-112) Programmed unit for two-dimensional analysis with fast-response analog-to-digital converter.** Kulinich, P.A.; Toledo, R. (Joint Inst. for Nuclear Research, Dubna (USSR). Lab. of Nuclear Problems). 1987. 7p. (In Russian). NTIS (US Sales Only), PC A02/MF A01. Order Number DE88703763/JAW.

Submitted to the journal Instrum. Exp. Tech. .

A unit designed for connection with the event selection logics is described. It allows digitizing two input parameters (i/sub inp/ or time) and producing a signal whose value is determined by the memory contents. The unit consists of two channels operating in the range of signals up to approximately 100 pKl. The charge-to-code conversion takes place in the unit. If a current generator is connected to each channel, the unit can be used as a time-to-code converter. The unit has a circuit of the RAM (K500PY415) which can be filled in and read by a computer through the CAMAC and two 6-bit FADC with ECL output (K1107PV3B). Only five senior bits are used in the unit. The unit is characterized by a small solution time approximately 110 ns and a small recovery time approximately 350 ns. The unit is made in the CAMAC standard in a 1 M block. 4 refs.; 3 figs.

43804 **(JINR-R—10-87-515) Measurement of point-like image coordinates using a linear CCD-camera.** Men'shikov, A.L.; Polyakov, V.N.; Prikhod'ko, V.I. (Joint Inst. for Nuclear Research, Dubna (USSR). Lab. of Computing Techniques and Automation). 1987. 7p. (In Russian). NTIS (US Sales Only), PC A02/MF A01. Order Number DE88703764/JAW.

A TV-camera based on a linear 2000-elements charge-coupled light sensor K1200CL2 has been designed. The camera is designed for measuring charged particle track coordinates. It is used for digitizing images and transferring them to DVK-2 microcomputer. Detection of a point-like image is usually performed by simple thresholding processing and its coordinate is calculated using simple procedures (center-of-gravity or center-of-square methods). The problem of measuring a point-like image is investigated using detection and estimation theory. Two procedures for estimating a point-like image coordinate are proposed. These procedures require few processing capabilities and allow to double the accuracy of measurement. 5 refs.; 2 figs.

43805 **(JINR-R—10-87-516) Linear CCD-camera and its noise characteristics.** Men'shikov, A.L.; Polyakov, V.N.; Prikhod'ko, V.I. (Joint Inst. for Nuclear Research, Dubna (USSR). Lab. of Computing Techniques and Automation). 1987. 7p. (In Russian). NTIS (US Sales Only), PC A02/MF A01. Order Number DE88703765/JAW.

A CCD-camera based on a linear 2000-element charge-coupled light sensor K1200Cl2 has been designed. Construction of the camera is described. Distortion brought to a digital image by the camera are analysed. Results of investigations of camera random noises are presented. 8 refs.; 3 figs.; 2 tabs.

43806 **(JINR-R—10-87-688) Multichannel pulse analyzer with a possibility to operate both in autonomous mode and under control of microcomputer.** Antyukhov, V.A.; Georgiev, A.; Zhuravlev, N.I.; Opalek, T.; Salamatin, A.V.; Sinaev, A.N.; Han Thek. (Joint Inst. for Nuclear Research, Dubna (USSR). Lab. of Nuclear Problems). 1987. 14p. (In Russian). NTIS (US Sales Only), PC A03/MF A01. Order Number DE88703767/JAW.

The basic set of MAK-2 analyser consisting of 4 modules is described: ADC on 4096 channels, memory increment controller, 8K 16 bit memory module and graphic display driver. All modules are in CAMAC standard. An example of a system for pulse high analysis including those and formerly designed modules is presented. The information on MAK-3 analyser is briefly reported. Its channel capacity is increased from 16 to 24 bit in comparison with MAC-2 analyser. 9 refs.; 7 figs.

43807 **(JINR-R—10-87-731) On an application of the algorithm of polynomial approximation for the calibration crosses.** Bogdanova, N.B.; Ososkov, G.A. (Joint Inst. for Nuclear Research, Dubna (USSR). Lab. of Computing Techniques and Automation). 1987. 8p. (In Russian). NTIS (US Sales Only), PC A02/MF A01. Order Number DE88703770/JAW.

Application of the algorithm of polynomial approximation for the determination of reference crosses in calibration data processing for Spiral Reader is described. The approximation is done directly in polar coordinate system that simplifies the calculations and increases their precision on the second stage of data processing. Results of comparative calculations according to the conventional and proposed methods are given. 7 refs.; 3 figs.; 3 tabs.

43808 **(JINR-R—13-87-774) Adaptable pulsed analog-to-digital converter.** Kuznetsov, A.N. (Joint Inst. for Nuclear Research, Dubna (USSR). Lab. of Nuclear Reactions). 1987. 10p. (In Russian). NTIS (US Sales Only), PC A02/MF A01. Order Number DE88703778/JAW.

Submitted to the journal Instrum. Exp. Tech. .

In order to increase the accuracy of measuring the low amplitude pulses analog-to-digital converter (ADC) is proposed which

step of quantization is adaptable for the value of input pulses. The ADC had conversion time comparable with the usual 10-bit successive type ADC, but for the pulses lower than 0.3 V its accuracy is equivalent to 14-bit ADC. The functional circuit of the ADC and its description are given as well as the results of the experimental investigations. Possibilities and peculiarities of the practical application of the ADC are discussed. 15 refs.; 3 figs.

43809 **(LBL—24972) Fourier transform infrared spectrometer and automated sample changing apparatus.** Pollard, M.; Jaklevic, J. (Lawrence Berkeley Lab., CA (USA)). Apr 1988. Contract AC03-76SF00098. 93p. NTIS, PC A05/MF A01; 1; GPO Dep. Order Number DE88014034/JAW.

A commercial Fourier transform infrared spectrometer was modified for automated analysis of Teflon air filters by the addition of a sample changing compartment capable of positioning up to 40 filters for analysis. Software was developed to automatically position the filter samples, control data acquisition, and analyze the resultant data using spectral and analysis together with empirical calibration curves. Both the hardware and software developments are described. 4 refs., 11 figs.

43810 **(SAND—87-1974) Push-pull, double-delay-leg or dual VISAR [Velocity Interferometer System for any Reflector].** Crump, O.B. Jr.; Stanton, P.L. (Sandia National Labs., Albuquerque, NM (USA)). May 1988. Contract AC04-76DP00789. 15p. NTIS, PC A03. Order Number DE88011276/JAW.

This report describes a new VISAR (velocity interferometer system for any reflector) built for Sandia Explosive Projects and Diagnostics Division 2514. The system incorporates push-pull signal processing, which reduces sensitivity to target self-light and simplifies data reduction. The system consists of two push-pull VISARs with two modes of operation. Each VISAR may be used independently to track separate targets or separate points on a used independently to track separate targets or separate points on a common target, or they may be used to track the motion of a single point. The latter redundant measurement is used to resolve the velocity jump ambiguity in shock-wave experiments. 6 refs., 14 figs.

43811 **Study of octupoles as correctors.** Shao, Z.; Beck, V.; Crewe, A.V. (Department of Physics and The Enrico Fermi Institute, The University of Chicago, 5640 South Ellis Avenue, Chicago, Illinois 60637). *Journal of Applied Physics;* **64**: No. 4, 1646-1651(15 Aug 1988).

In an electron microscope equipped with sextupole correctors the ultimate resolution is limited by the fifth-order spherical aberration of the optical system used to form the electron probe. We have examined the possibilities of using octupoles in order to correct this fifth-order spherical aberration. We find that for an electrostatic octupole, the fifth-order aberration is symmetric, while for a magnetic octupole the fifth-order aberration is asymmetric but it is possible to reduce this asymmetry by properly arranging the initial conditions. Based on these results, we propose a system which could be used to correct fifth-order aberration in a probe forming system equipped with a sextupole corrector.

43812 **Optical processor for recognition of three-dimensional targets viewed from any direction.** Schils, G.F.; Sweeney, D.W. (Imaging Technology Division, Sandia National Laboratories, Livermore, California 94550). *Journal of the Optical Society of America A: Optics and Image Science;* **5**: No. 8, 1309-1321(Aug 1988).

A procedure is presented for generating a small bank of optical correlation filters that can recognize a large number of perspective views of an object. The method applies to general kinds of image distortions in addition to those generated by different perspective views. The holographic filters are also invariant to image intensity and position (translation invariance). The method of design is to decompose the entire set of object variations into a set of eigenimages. These eigenimages contain complete information about the target set. An iterative procedure combines the eigenimages with different relative phases, so that complete target information can be extracted in an optical implementation. An example illustrates that a set of only 20 holographic filters recognizes a three-dimensional target over a continuous range of viewing angles.

43813 **High-efficiency, energy-scalable, coherent 130-nm source by four-wave mixing in Hg vapor.** Muller C.H. III; Lowenthal, D.D.; DeFaccio, M.; Smith, A.V. (Spectra Technology, Inc., 2755 Northup Way, Bellevue, Washington, 98004). *Optics Letters;* **13**: No. 8, 651-653(Aug 1988).

Coherent vacuum-ultraviolet (VUV) pulses with energy of 1.1 mJ, 2.2-nsec pulse length (2 MW cm/sup -2/ unfocused), and measured bandwidth A0.1 cm/sup -1/ have been achieved at 130 nm from four-wave mixing in Hg vapor. Conversion efficiencies of 5% have been demonstrated in a collimated beam geometry over 1-m interaction lengths. These high efficiencies are made possible by using two-photon-resonant sum-frequency mixing through the Hg 7^1S level. The experimental facility assembled to produce this efficient VUV source is described, and a comparison between experimental measurements and theory is provided.

43814 **Automated search for supernova explosions.** Kare, J.T.; Burns, M.S.; Crawford, F.S.; Friedman, P.G.; Muller, R.A.; Pennypacker, C.R.; Perlmutter, S.; Treffers, R.; Williams, R. (Lawrence Berkeley Laboratory, Berkeley, California 94720). *Review of Scientific Instruments;* **59**: No. 7, 1021-1030(Jul 1988).

We describe the design and construction of a new search for supernovae, based on the use of current computer and detector technology. This search uses a computer-controlled telescope and charge coupled device (CCD) detector to collect images of hundreds of galaxies per night of observation, and a dedicated minicomputer to process these images in real time. The search system has a detection threshold of 17th visual magnitude, discovered its first supernova on 18 May 1986, and at this writing has found three additional supernovae. The system currently is being upgraded with an improved detector and a more powerful computer. At full speed and sensitivity, the system will be able to search 2500 galaxies per night with a limiting magnitude of 19 or fainter.

43815 **Rotary turret and reusable specimen holder for mass spectrometer.** Banar, J.C.; Perrin, R.E.; Springs, J.; Ostrenga, R.A. (to Dept. of Energy, Washington, DC). US Patent 4,745,277. 17 May 1988. Filed date 6 Oct 1986. vp. Patent and Trademark Office, Box 9, Washington, DC 20232.

A turret assembly for rotatably supplying material samples for mass spectrographic analysis is described comprising: holder means for mounting material samples with each of the material samples exposable for the spectrographic analysis; rotatable electrical radial contact means for heating a first of the samples for analysis and heating a second of the samples for pretreatment where the second sample is angularly separated from the first sample for effective contamination control; substantially solid body means for supporting and relatively rotating the electrical radial contact means and the holder means while aligning the holder means for the spectrographic analysis; and housing means about the holder means and the rotatable electrical contact means for establishing and maintaining a vacuum.

43816 **Methods of and apparatus for levitating an eddy current probe.** Stone, W.J. (to Dept. of Energy, Washington, DC). US Patent 4,742,299. 3 May 1988. Filed date 15 Oct 1986. vp. Patent and Trademark Office, Box 9, Washington, DC 20232.

Pointing apparatus for supporting and presenting an eddy current probe normal to an in proximity with a specimen in a vertical plane, the apparatus is described comprising: translating base means for movement normal to the specimen plane; a floatable member having an eddy current probe fixed thereto; air bearing means, supported on the base means, for levitating the floatable member with respect to the base means in a vertical direction against the force of gravity; biasing means, cooperating with the air bearing means, for urging the floating member toward the specimen in a horizontal direction; and pneumatic means for displacing the floating member and probe perpendicular to the specimen against the force of the biasing means, whereby the eddy current probe examines the specimen while displaced therefrom in the horizontal direction and while levitating with respect to the base in the vertical direction.

4404 Well Logging Instrumentation

REFER ALSO TO CITATION(S) 42724, 42955

45 EXPLOSIONS AND EXPLOSIVES

43817 **(SAND—88-0678) Aerosol production by high-velocity molten-metal droplets.** Rader, D.J.; Benson, D.A. (Sandia National Labs., Albuquerque, NM (USA)). Jun 1988. Contract AC04-76DP00789. 47p. NTIS, PC A04/MF A01; 1; GPO Dep. Order Number DE88013141/JAW.

This report presents the results of an experimental study of the aerosol produced by high-velocity molten-metal droplets. These tests are intended to simulate the reduction of high-velocity fragments into aerosol in high-explosive detonations or reactor accidents involving nuclear materials. The primary droplets are produced by the heating and electromagnetic launch of metal wires; velocities approaching Mach 1 can be obtained at present. Size distributions obtained tungsten and zirconium droplets burning in air. Lognormal size distributions were observed in both cases with DMPS-equivalent mean diameters of about 0.4 μm and geometric standard deviations of about two. SEM and TEM analysis of aerosol samples collected by a point-to-plane electrostatic precipitator showed that the majority of these particles were web-like chain agglomerates. Tests performed in argon atmospheres produced several orders-of-magnitude less aerosol mass than in equivalent air tests, supporting the key role combustion plays in secondary aerosol generation. 26 refs., 14 figs., 2 tabs.

43818 **(UCID—21379) HEAF [High Explosives Application Facility] electronics special facilities: Detailed requirements for diagnostics and data acquisition.** Rector, N.L. (Lawrence Livermore National Lab., CA (USA)). Jan 1988. Contract W-7405-ENG-48. 31p. NTIS, PC A03/MF A01;1; GPO Dep. Order Number DE88010601/JAW.

This document provides system designers detailed electronic requirements for the HEAF (High Explosive Applications Facility) facility. These function and performance requirements have been agreed to by the Program. They meet the operational needs of HEAF. A description of the approach used in establishing system requirements coupled with a broad description of diagnostic tools used by the experimenters preface the detailed requirements.

4501 Chemical

43819 **Reactive flow model for a monomolecular high explosive.** Nutt, G.L. (University of California Lawrence Livermore National Laboratory, P. O. Box 808, Livermore, California 94550). *Journal of Applied Physics;* **64**: No. 4, 1816-1826(15 Aug 1988).

The thermodynamics of a reacting fluid element is discussed in a context appropriate to a hydrodynamic computer code. This is followed by a treatment of reaction initiation and reaction growth with reference to global reaction rates measured by reactive flow Lagrange analysis. The reactant and product gases are represented in the equation of state of the fluid element as two unmixed phases. The parameters in a common phenomenological representation of the global reaction rate are fit to the measured rate, and fine tuned by iterative code calculations of measured flow variables. We discuss changes in the form of the rate equation which would improve the agreement with experiment.

4502 Nuclear

43820 **(AD-A—191992/7/XAB) Equipment test methods for externally produced electromagnetic transients. Issue 2. Technical memo.** Hobbs, R.A. (Royal Aircraft Establishment, Farnborough (UK)). Jul 1987. 35p. (RAE-TM—457). NTIS, PC A03/MF A01.

Supersedes Issue 1, DRIC-BR-84221.

This memorandum assesses the effect of electromagnetic-pulse and lightning-strike produced transients to aircraft systems. It details suitable tests for the simulation of these effects and should be used to form the basis of any future aircraft project transient specifications.

43821 **(RFP—4229) Quality by design in the nuclear weapons complex.** Ikle, D.N. (Rockwell International Corp., Golden, CO (USA). Rocky Flats Plant). 1 Apr 1988. Contract AC04-76DP03533. 18p. (CONF-8806126—1; CONF-8806126—). NTIS, PC A03/MF A01;1; GPO Dep. Order Number DE88009835/JAW.

From Rocky Mountain SQC and A conference; Denver, CO, USA (7 Jun 1988).

Modern statistical quality control has evolved beyond the point at which control charts and sampling plans are sufficient to maintain a competitive position. The work of Genichi Taguchi in the early 1970's has inspired a renewed interest in the application of statistical methods of experimental design at the beginning of the manufacturing cycle. While there has been considerable debate over the merits of some of Taguchi's statistical methods, there is increasing agreement that his emphasis on cost and variance reduction is sound. The key point is that manufacturing processes can be optimized in development before they get to production by identifying a region in the process parameter space in which the variance of the process is minimized. Therefore, for performance characteristics having a convex loss function, total product cost is minimized without substantially increasing the cost of production. Numerous examples of the use of this approach in the United States and elsewhere are available in the literature. At the Rocky Flats Plant, where there are severe constraints on the resources available for development, a systematic development strategy has been developed to make efficient use of those resources to statistically characterize critical production processes before they are introduced into production. This strategy includes the sequential application of fractional factorial and response surface designs to model the features of critical processes as functions of both process parameters and production conditions. This strategy forms the basis for a comprehensive quality improvement program that emphasizes prevention of defects throughout the product cycle. It is currently being implemented on weapons programs in development at Rocky Flats and is in the process of being applied at other production facilities in the DOE weapons complex. 63 refs.

4503 Explosion Detection

43822 **(SAIC—87/1752) Seismic monitoring capability in the Soviet Union using hypothetical regional networks: Final technical report, February 1986-August 1987.** Bratt, S.R.; Bache, T.C.; Williams, D.J. (Science Applications International Corp., San Diego, CA (USA)). 18 Aug 1987. 72p. Science Applications International Corporation, 10210 Campus Point Drive, San Diego, CA 92121. Order Number TI88900631/JAW.

The capabilities of hypothetical networks designed for nuclear test monitoring in the Soviet Union are described. This is done with a network simulation program that is an extension of the SNAPD program for computing the detection threshold and location uncertainty for a specified seismic network. Our hypothetical networks all include 13 high quality arrays external to the Soviet Union. To this network we add from 10 to 50 evenly spaced arrays and stations within the Soviet Union and determine the effects on monitoring capability. We have extended the location uncertainty calculations in SNAPD to include the contribution of azimuth estimates from arrays and three-component stations and to estimate the uncertainty from a suite of Monte-Carlo realizations of the sets of detecting stations. The key to valid simulations is accurate normalization to empirical experience; that is, to select appropriate values for the parameters controlling the simulation results. These include the amplitude-distance curves, the station detection thresholds, the source assumptions, and the assumed variance. Our normalization is based om empirical experience with the NORESS array in Norway, but we carefully explore the effect of changing the important assumptions. As a result of this analysis, we are able to place bounds on the detection threshold and location uncertainty for these hypothetical networks which are expressed in tables and plots. We find that achieving a detection threshold of m/sub b/ 2.5 throughout the Soviet Union would require one or more of the fol-

lowing: (1) 20 or more in-country arrays of NORESS type; (2) seismic wave propagation in the Soviet Union that is more efficient than we observe near NORESS; (3) station sites that have significantly lower detection thresholds than NORESS; (4) a significantly improved ability to process and analyze seismic data.

43823 **Spectral discrimination of NTS explosions and earthquakes in the southwestern United States using high-frequency regional data.** Chael, E.P. (Sandia National Laboratories, Albuquerque, NM). *Geophysical Research Letters;* **15**: No. 6, 625-628(Jun 1988).

A high-frequency seismic station has been operating since March, 1987, near Nelson, NV. Records of earthquakes at regional distances from the station show substantially more energy at frequencies above 10 Hz than records of nuclear tests of comparable magnitude on the Nevda Test Site. This contradicts the predictions made by investigators who have advocated high-frequency monitoring for nuclear test detection and identification. Measuring the slopes of the P/sub g/ velocity spectra between 4 and 30 Hz successfully discriminates 11 NTS explosions from 36 earthquakes recorded in the first seven months of operation. The spectral differences may result from the respective source depths, with the earthquakes occurring deeper and in faster material than the explosions. copyright American Geophysical Union 1988

50 ENVIRONMENTAL SCIENCES, ATMOSPHERIC

REFER ALSO TO CITATION(S) 43923

5001 Basic Studies

REFER ALSO TO CITATION(S) 43566, 43576, 43584, 43817

43824 (CONF-8708252—, pp 21, Paper 4) **Climate patterns in China and the US.** Wang, W.; Ronberg, B.; Portman, D. (Atmospheric & Environmental Research, Inc., Cambridge, MA (USA)). Jun 1988. NTIS, PC A09/MF A01. Order Number DE88011540/JAW.

From 2. science team meeting of the United States DOE and Peoples Republic of China academia; Harpers Ferry, WV, USA (26 Aug 1987).

In this study, the authors have further analyzed the 510-year Chinese precipitation proxy index in order to compare the climate patterns (climate regions and interregional relationship) between the last 100 years and the period of Little Ice Age when the mean temperature over China was about 2°C cooler than at present. Since the climate patterns are derived from the anomaly, the area within a climate region is expected to respond similarly when climate is perturbed. To explore the usefulness of the information of climate patterns for the purpose of model-to-data comparison, they have used the US Historical Climate Data Network (HCN). They identify the climate patterns in the US and then calculate the averages of climate parameters within the GCM grid utilizing this information. They show some examples using the NCAR and GFDL models.

43825 (INIS-mf—11210, pp III32-III34/a) **Israel electric corporation meteorological tower in the Negev - a first examination of the data.** Balmor, Y.; Gutman, A.; Kovacs, S. (Israel Electric Corp. Ltd., Haifa (Israel). Dept. of Environmental and Efficiency Control). Dec 1987. NTIS (US Sales Only), PC A13/MF A01. Order Number DE88780087/JAW. (CONF-871287—).

From Nuclear Societies of Israel annual meeting; Haifa, Israel (21 Dec 1987).

Transactions.; V. 14.

43826 (Juel—2182) **Recent climatic-geographical dynamics of the variability of European main climate elements. A multivariate analysis of the climate geography of Europe.** Kirstein, W. (Kernforschungsanlage Juelich G.m.b.H. (Germany, F.R.). Forschungsgruppe Wirtschaft, Energie, Investitionen). Feb 1988. 151p. (In German). Kernforschungsanlage Juelich G.m.b.H. (Germany, F.R.). Zentralbibliothek.

The complex variability of atmospheric pressure, temperature and precipitation as determined of 62 European climate stations has been analyzed and typified on the basis of their respective annual means. With the help of factor analysis, a well-proven technique of multivariate statistical analysis, 45 individual tests have been carried out presenting the results 'geographically'. At the same time an insight into climatic-geographical dynamics was possible, regarding the sequence of temporal-constant periods (decades) within the time of study (1821-1970). The variations of atmospheric pressure and temperature enable the localization of some larger spatial regions of homogeneous fluctuation behaviour, the so-called 'characteristic regions'. There are three temporal phases distinguishable within the database of a 150-year period of atmospheric pressure and temperature. These phases express different spatial overall structures in Europe. The variability of the three climatological elements exhibits a corresponding phenomenon only in Central Europe: a trend of expansion of homogeneous fluctuation behaviour approximately over the last third of the period of study. Using this methodology the expansion can be interpreted neither as a naturally based nor as an anthropogeneous effect. At present no indication of a natural and regionally significant expansion is perceptible; however a possible connection exists to the anthropogeneous thesis.

43827 **Development of a nested grid, second moment turbulence closure model and application to the 1982 ASCOT Brush Creek data simulation.** Yamada, T.; Bunker, S. (Earth and Space Science Division, Los Alamos National Laboratory, Los Alamos, New Mexico). *Journal of Climate and Applied Meteorology;* **27**: No. 5, 562-578(May 1988).

An improved, second-moment turbulence-closure model and a random particle kernel diffusion model are described and tested with the 1982 ASCOT (Atmospheric Studies in Complex Terrain) data collected in Brush Creek, Colorado. Three improvements of the models are the nested grid capability, inclusion of terrain shadows and application of a kernel method for concentration estimation. The present models are unique in a sense that wind variances needed for the computation of transport and diffusion of airborne materials are obtained directly from the second-moment turbulence-closure model.

43828 **Eddy correlation measurements of the dry deposition of particles in wintertime.** Duan, B.; Fairall, C.W.; Thomson, D.W. (Department of Meteorology, Pennsylvania State University, University Park, Pennsylvania). *Journal of Climate and Applied Meteorology;* **27**: No. 5, 642-652(May 1988).

Eddy correlation measurements of the vertical fluxes of particles, momentum, heat and water vapor, were conducted over a partially snow covered field in central Pennsylvania during December 1985. The PMS ASASP-300 and CSASP-100-HV optical counters were used as sensors to measure particle-number fluxes. Overall, average dry deposition velocities for 28 half-hour runs were found to be 0.34 +- 0.014 and 0.021 +- 0.005 cm s^{-1} for particles in two size ranges, 0.15—0.30 and 0.5—1.0 μm, respectively. The average deposition velocity was close to results from prior wind-tunnel and theoretical investigations. These results were also comparable with those reported by other authors over grass. Relatively large sampling rates reduced the effects of counting noise on deposition measurements of 0.5—1.0 μm particles. Small correlation coefficients between vertical velocity and the particle concentration were found even after corrections for the effects of counting noise. The normalized average surface deposition velocity v/sub d//sub s//u/sub */ for particles in diameter of 0.15—0.30 and 0.5—1.0 μm appeared to be 0.006 and 0.002, respectively, in nearly neutral and stable conditions.

43829 **Sensitivity of soil moisture to doubling of carbon dioxide in climate model experiments. Part I: North America.** Kellogg, W.W.; Zong-Ci Zhao. (National Center for Atmospheric Research, Boulder, Colorado). *Journal of Climate;* **1**: No. 4, 348-366(Apr 1988).

In anticipation of a global warming in the decades ahead due to an increased greenhouse effect from infrared-absorbing trace gases, it is not too early to enquire what this may mean in terms of changes in patterns of precipitation and soil moisture. These pat-

terns are a secondary result of the temperature distribution and are therefore difficult to specify, but the practical importance attached to any regional changes in soil moisture is obviously enormous. In this study we have attempted to see how experiments with climate models reveal regional soil moisture changes over North America when carbon dioxide is doubled (or the equivalent radiation perturbation due to an increase in all the "greenhouse gases" takes place). Results from five of the current state of the art climate models are compared with each other and with existing estimates of soil moisture distribution, with emphasis on how they respond to the carbon dioxide perturbation. (The models are those of GFDL, GISS, NCAR, OSU, and UKMO). There is considerable difference between the soil moisture formulations and the resulting outputs of these five models in terms of soil moisture distribution changes, but some general conclusions can be drawn nevertheless: (i) The agreement between models is considerably better in the wintertime than in the summertime; (ii) one subset of the models agrees remarkably well in winter, while a different subset shows better agreement in summer, (iii) we can tentatively conclude on the basis of the model experiments that in winter there may be an increase in soil moisture in North America at high latitudes and an onset of drier conditions in the southern states and Mexico; and (iv) that in summer there may be a tendency toward drier conditions in the middle of the continent together with wetter conditions along the Gulf Coast and the West Coast of the United States and Canada.

43830 **Sensitivity of soil moisture to doubling of carbon dioxide in climate model experiments. Part II: The Asian monsoon region.** Zhong-Ci Zhao; Kellogg, W.W. (Department of Geophysics, Peking University). *Journal of Climate;* 1: No. 4, 367-378(Apr 1988).

This is a sequel to a comparative study of the performance of five climate models over North America; here we investigate their performance over the region most directly under the influence of the Asian monsoon (taken to be equator to 60 °N, 60° to 140 °E). Emphasis is on soil moisture, since it is a difficult parameter to calculate and therefore provides a severe test of the climate models. Furthermore, soil moisture is a quantity of considerable concern to agriculture and the management of ecological systems generally. The five models compared were those of GFDL, GISS, NCAR, OSU and UKMO. While there were many significant differences in detail between the soil moisture distributions produced by the various control runs for winter and for summer, and also between the model climates and the observed climate of the region, the largest scale features were generally simulated quite well. These features are a considerably drier average climate in the northern part of our region compared to the southern part, with the season of highest soil moisture occurring in the mid-to-late winter in the northern part and the mid-to-late summer in the southern part. We then compared the results of five climate model sensitivity experiments in which the carbon dioxide content of the atmosphere was doubled, resulting in a warmer average temperature for the Earth. In a majority of the five cases there was apparently an intensification of the seasonally changing monsoon circulation, since in the southen part (most of India and Southeast Asia) there was a change toward drier winters and wetter summers. In the northern part of the region the reverse was generally true, with the magnitude of the summertime drying trend being most pronounced in the area around Manchuria.

43831 **Following the trail of antarctic winds.** Mroz, E.J.; Alei, M.; Cappis, J.H.; Guthals, P.R.; Mason, A.S.; Rokop, D.J. (Los Alamos National Lab., NM (USA)). *Antarctic Journal of the United States;* 21: No. 5, 231-232(1986).

The transport of tropospheric air masses from the north to the south (longitudinal transport) is responsible for bringing aerosols and trace gases to Antarctica from the lower latitudes. The atmospheric materials and pollutants from both natural and anthropogenic sources may then become part of the geological climatic record if they are trapped in the southern polar ice sheet. If one is to use this record to evaluate the potential greenhouse and albedo effects of air pollutants on global climate, one needs to understand the transport mechanisms involved. The antarctic tracer experiment was designed to improve the scientific comprehension of these north-south transport processes by the use of unique atmospheric tracers. Heavy methanes were chosen to track the antarctic winds. These are the heavy isotopic analogues of methane - so named because they are composed of the heavy isotopes of carbon and hydrogen, namely carbon-13 and deuterium. The authors released specific amount of $^{13}CD_4$ and $^{13}CD_4$ gas into the antarctic atmosphere and subsequently conducted air and surface sampling in search of the tracer gas. Sampling and mass spectrometric analysis techniques developed by Los Alamos National Laboratory's Isotope and Nuclear Chemistry Division can detect these tracers in quantities as small as a few parts in 10^{17} in air. Because of their extremely low natural abundance, their long atmospheric lifetime, and the high sensitivity for their detection, these isotopically unique methanes are ideal for experimentally tracking air masses in Antarctica over long periods of time and more than 4000 kilometers from the release point. Results are discussed.

5002 Chemicals Monitoring And Transport

REFER ALSO TO CITATION(S) 42627, 43043, 43248, 43388, 43389, 43693, 43857, 43971, 43979

43832 (CONF-8708252—, pp 18, Paper 6) **CH_4 flux from biogas generators and rice paddies as measured in Sichuan, China: preliminary findings.** Wang, M.; Khalil, M.A.K.; Rasmussen, R.A. (Institute of Atmospheric Physics, Beijing (China)). Jun 1988. NTIS, PC A09/MF A01. Order Number DE88011540/JAW.

From 2. science team meeting of the United States DOE and Peoples Republic of China academia; Harpers Ferry, WV, USA (26 Aug 1987).

Methane emission rates are reported from several biogas generators and from rice paddies in Sichuan, China. The rates from the seals of biogas generators vary greatly from pit to pit, ranging between 0.037 and 50 g/day/pit. If this result was representative for the whole year and for all the biogas pits in China, it would result in a total annual CH_4 release of 1×10^8 to 1.5×10^{11} g for the 8 million biogas pits now used in China. However, there are other areas of biogas pits from which CH_4 can leak. CH_4 flux from rice paddies varies significantly from place to place and from time to time. The measured CH_4 fluxes are largest during the seedling stage and shortly before harvest, ranging from 3.1 to 2889 mg/m²/day. Air bubbles, commonly seen in the seedling beds, transport CH_4, contributing significantly to the total gas emission. CH_4 flux routinely measures significantly higher at those locations where air bubbles are present.

43833 **(CONF-8804153—1) Review of acid rain models for Europe.** Streets, D.G. (Argonne National Lab., IL (USA)). 1988. Contract W-31-109-ENG-38. 43p. NTIS, PC A03/MF A01; 1; GPO Dep. Order Number DE88011945/JAW.

From Task force meeting on integrated assessment modeling executive body for the convention on long-range transboundary air pollution; Laxenburg, Austria (13 Apr 1988).

This report presents the results of a critical review of three European acid rain models: Rains, Bicram, and Acidrain. The models are reviewed in the context of the needs of a UNECE Task Force on Integrated Assessment Modeling, which desires to contribute to decisions on acid rain control strategies for Europe. The Rains model is a PC-based simulation model that can evaluate the effects of acidic deposition on aquatic and terrestrial resources. Emissions and control technology information is sufficient to examine the effects of alternative control strategies. The Rains model could be used now to investigate the cost-effectiveness of alternative control measures in Europe and to give a rough estimate of reduced damage to aquatic and terrestrial resources. The Bicram model is a PC-based, noninteractive model that has similar emissions and cost capability to Rains. It treats ecological damage through an empirical scheme of regional sensitivity measures and critical deposition loadings. Bicram could be used alone to compare alternative control strategies, but is unable to make damage estimates. The somewhat more detailed emissions and control cost modules of Bicram should be compared with those of Rains. The Acidrain model is a PC-based model designed as a decision aid for policy makers. Its strengths are its interactive, user-friendly software and its rigorous treatment of uncertainty using probability distributions. Before use by the Task Force, it would need to be re-

fined geographically and adapted to the European, rather than UK, context, Credible cost and damage functions need to be developed, either through expert judgment elicitation or derivation of regional dose-response functions from a model such as Rains.

43834 **(CONF-8806123—1) Near-real time infrared observations of acidic sulfates in {open←quotes}clean{close←quotes} air at Mauna Loa, Hawaii.** Johnson, S.A.; Kumar, R. (Argonne National Lab., IL (USA)). 1988. Contract W-31109-ENG-38. 5p. NTIS, PC A02/MF A01;1; GPO Dep. Order Number DE88010047/JAW.

From Symposium on the chemistry of acid rain: effect and abatement; Toronto, Canada (5 Jun 1988).

Sulfuric acid and its partially or completely neutralized salts with ammonia are believed to result from the oxidation of sulfur dioxide in cloud water and in other heterogeneous media present in the atmosphere. Due to the natural abundance of ammonia and the ubiquitous presence of sulfur in the atmosphere, $(NH_4)_2SO_4$ is commonly the dominant chemical species in the ambient aerosol. The amounts of ammonium sulfates are expected to be very low in areas far removed from anthropogenic emissions of sulfur dioxide. The chemical composition of submicrometer aerosol particles was determined at the Mauna Loa Observatory (MLO) on Mauna Loa in Hawaii during an eight-day period in August 1986. The MLO site was selected for this measurement because it is the only ground-based aerosol observatory in the remote Pacific Ocean that allows extended sampling of aerosols in the free troposphere. Measurements were made using an attenuated total internal reflection (ATR) impactor system. The impactor collects size-fractionated submicrometer particles for analysis by ATR infrared spectroscopy. The collected samples were analyzed using an on-site Perkin Elmer dispersive infrared spectrophotometer. Infrared absorption spectra (4000 to 250 cm/sup {minus/1}) of the samples were obtained within minutes after the ATR substrates were removed from the impactor. Absorbances were measured for sulfate, nitrate, and ammonium. Acidic sulfate showed infrared absorbances at 600 cm/sup {minus/1} and 1210 cm/sup {minus/1} in addition. Results showed that ammonium sulfate was the dominant chemical species in the submicrometer particles. Over half of the nearly 40 samples collected showed an acidic sulfate component. Consecutive samples were found to change from completely neutralized ammonium sulfate to acidic ammonium sulfates in a two-hour time interval. 5 refs., 1 tab.

43835 **(CONF-8806123—2) Historical and future emissions of acidic deposition precursors from man-made sources.** Placet, M.; Streets, D.G. (Argonne National Lab., IL (USA)). 1988. Contract W-31109-ENG-38. 6p. NTIS, PC A02/MF A01;1; GPO Dep. Order Number DE88010024/JAW.

From Symposium on the chemistry of acid rain: effect and abatement; Toronto, Canada (5 Jun 1988).

Three pollutants—sulfur dioxide (SO_2), nitrogen oxides (NO/sub x/) and volatile organic compounds (VOC)—have been targeted as the primary species involved in the atomospheric chemical reactions that produce acidic deposition. This paper will review estimates of current and historical emissions and analyze projections of future emissions of these pollutants. Historical changes in emission levels can be used in the investigation of long-term trends in precipitation acidity, dry deposition, air quality, and cumulative effects on forest, aquatic systems, and agricultural and material resources. Projections of future emissions aid in the assessment of the possible future intensity and geographical distribution of acidic depositon that might occur in the absence of additional control measures and in the analysis of the effectiveness and costs of possible new measures to reduce emissions.

43836 **(CONF-8806123—3) Aerosol nitrate and sulfate: Measurements by three different co-located samplers.** Johnson, S.A.; Kumar, R. (Argonne National Lab., IL (USA)). 1988. Contract W-31109-ENG-38. 6p. NTIS, PC A02/MF A01;1; GPO Dep. Order Number DE88010046/JAW.

From Symposium on the chemistry of acid rain: effect and abatement; Toronto, Canada (5 Jun 1988).

Atmospheric aerosol samples were collected and analyzed at Argonne National Laboratory near Chicago, Illinois, at irregular times during the summer and fall of 1986. Three different sampling techniques were used: the {open←quotes}Canadian Filter Pack{close←quotes} (CFP) collected aerosol particles and reactive gases on separate teflon membrane filters, the Annular Denuder System (ADS) removed the acidic and basic gases from the sampled air stream before the particles were collected on a teflon membrane filter; and the Attenuated Total internal Reflection (ATR) impactor collected size-fractionated submicrometer aerosol particles on KRS-5 internal reflection elements. The CFP and ADS collected 24-hour samples, while the ATR collected consecutive 4 or 6 hour samples. Particle samples collected by each of the three different techniques were analyzed for nitrate, sulfate, bisulfate, ammonium, and other ionic species by Fourier-transform infrared (FTIR) spectroscopy, either directly from the sample filters or from the internal reflection elements. Significant differences were observed in the nitrate content of the samples collected by the three different techniques. Further, the measured nitrate levels changed during storage. In many ATR samples the nitrate content decreased over a storage period of hours to weeks; in some cases the nitrate disappeared completely; some other samples showed a stable nitrate content after an initial decrease; and in at least one case, a high level of nitrate persisted over a long storage time. This {open←quotes}volatile{close←quotes} nitrate was observed only in the ATR samples; samples from the CFP and ADS showed only the stable nitrate. 5 refs., 3 figs.

43837 **(EUR—10563-EN) Facts and uncertainties about acid rain.** Benarie, M. (Commission of the European Communities, Luxembourg). 1986. 54p. Commission of the European Communities, Luxembourg.

This is a review of the topic 'acidic depositions'. It points out the areas of well-established facts and other fields still open to debate and therefore requiring further research. Damages caused by acidic depositions are: loss in fish stocks; deterioration of stones and structural materials. Neither human health effects, nor crop losses can be clearly linked to acid rain. Acid deposition may be a co-factor of: Forest damages in Central Europe. No prejudice could be established in Scandinavia. There are areas of future concern: Soil acidification and surface and ground water quality deterioration. The lack of reliable source-receptor relationships and the insufficiency of trend information does not allow firm opinions. These are other areas for future research. The probable money value of the losses is evaluated. The technical means to curtail emissions are available. Their application would represent about 10 per cent additional expense to the actual energy bills. Some actions of the Commission of the European Communities to safeguard the future and to promote research are discussed.

43838 **(GKSS—87/E/56) Velocity of a stack plume from infrared video records.** Boettcher, G.; Kolb, M. (GKSS-Forschungszentrum Geesthacht G.m.b.H., Geesthacht-Tesperhude (Germany, F.R.). Inst. fuer Physik). (GKSS-Forschungszentrum Geesthacht G.m.b.H., Geesthacht-Tesperhude (Germany, F.R.); GKSS-Forschungszentrum Geesthacht G.m.b.H., Geesthacht-Tesperhude (Germany, F.R.). Inst. fuer Physik). 1987. 16p. (In German). NTIS (US Sales Only), PC A03/MF A01. Order Number DE88753777/JAW.

Images have to be obtained from the plume of a stack for calculating the plume's velocity by digital picture correlation. Visible light images of dustfree and dry plumes in front of an overcast sky often show little or no contrast, therefore an infrared (2 to 5 μm) imaging system was put to a first test. The thermal images were recorded and transferred direct to the digital picture processing system. (orig.) With 8 figs.

43839 **(KFK-PEF—36) Simulation of the photooxidation of biogenic hydrocarbons of forests in consideration of the impact of NO/sub x/ and anthropogenic hydrocarbons.** Nolting, F.; Zetzsch, C. (Fraunhofer-Institut fuer Toxikologie und Aerosolforschung (ITA), Hannover (Germany, F.R.)). (Kernforschungszentrum Karlsruhe G.m.b.H. (Germany, F.R.). Projekt Europaeisches Forschungszentrum fuer Massnahmen zur Luftre; Fraunhofer-Institut fuer Toxikologie und Aerosolforschung (ITA), Hannover (Germany, F.R.)). Jul 1987. 48p. (In German). NTIS (US Sales Only), PC A03. Order Number DE88753784/JAW.

A thermostated smog chamber, combined with gas chromatographic trace analysis, was designed to simulate the photochemical degradation of terpenes in the ppbv-level. A new method of evaluation, adopted for a test guideline of the OECD, is employed to determine simultaneously the reactivity against ozone and OH. The reactivity of 19 olefins against ozone and of 15 hydrocarbons against OH was determined. Furthermore, the formation of OH radicals originating from O/sub 3/-degradation of olefins could be detected, even in the absence of light. For a transient product formed from α-pinene, pinonic acid, the reactivity against OH could be determined in the aerosol-borne state. In simulation experiments of photosmog for the biogenic α-pinene a lower ozone forming potential was observed than for the anthropogenic cis-butene-(2) and propene. (orig.) With 16 figs., 30 refs.

43840 **(NILU-TR—1/87) Precipitation and air chemistry at the Norwegian background stations, 1984.** Hoem, K.; Joranger, E. (Norsk Inst. for Luftforskning, Lillestroem). Jan 1987. 23p. NTIS (US Sales Only), PC A03. Order Number DE88752095/JAW.

The report presents the precipitation quality data measured in 1984 at 22 Norwegian background stations. The chemical compositions are given as monthly and annual values. Annual values from the start of each station are also given. Air concentrations of sulphur dioxide and particulate sulphate were measured at 8 stations, and presented as monthly and annual averages. 1 drawing, 26 tables.

43841 **(NILU-TR—3/87) Precipitation and air chemistry at the Norwegian background stations, 1985.** Hoem, K.; Joranger, E. (Norsk Inst. for Luftforskning, Lillestroem). Apr 1987. 25p. NTIS (US Sales Only), PC A03/MF A01. Order Number DE88752096/JAW.

The report presents the precipitation quality data measured in 1985 at 22 Norwegian background stations. The chemical compositions are given as monthly and annual values. Annual values from the start of each station are also given. Air concentrations of sulfur dioxide and particulate sulphate were measured at 7 stations, and presented as monthly and annual averages. 1 drawing, 26 tables.

43842 **(ORNL/M—560) Biomedical and environmental sciences programs at the Oak Ridge National Laboratory.** Richmond, C.R.; Johnson, C.A. (Oak Ridge National Lab., TN (USA)). Feb 1988. Contract AC05-84OR21400. 86p. NTIS, PC A05;3. Order Number DE88012148/JAW.

This progress report summarizes the research and development activities conducted in the Biomedical and Environmental Sciences Programs of Oak Ridge National Laboratory. The report is structured to provide descriptions of current activities and accomplishments in each of the major organizational units. Following the accounts of research programs, is a list of publications and awards to its members. 6 figs., 14 tabs.

43843 **(PB—88-198601/XAB) Hazardous-waste treatment, storage, and disposal facilities (TSDF)-air emission models (for microcomputers). Software.** McDonald, R.; Janes, D. (Environmental Protection Agency, Research Triangle Park, NC (USA). Office of Air Quality Planning and Standards). Dec 1987. vp. NTIS CP D02.

The software is contained on 5 1/4-inch diskette, double sided, double density, compatible with the IBM PC microcomputer. Diskettes are in LOTUS 1-2-3 format. Price includes documentation, PB—88-198619.

Analytical models are presented for estimating air emissions from Hazardous Waste Treatment, Storage, and Disposal Facilities (TSDF). Air-emission models were developed for aerated and non-aerated surface impoundments, land treatment facilities, landfills, and waste piles. Emission model predictions are compared to available field data. The models have been assembled into a spreadsheet (Lotus 1-2-3) that is included in the report as floppy diskette for use on microcomputers...Software Description: The software was programmed using the Lotus 1-2-3 Spreadsheet for implementation on the IBM-PC computers.

43844 **(PNL-SA—14732) Cross-valley structure of the valley atmosphere during the temperature inversion breakup period.** Whiteman, C.D.; McKee, T.B. (Pacific Northwest Lab., Richland, WA (USA); Muenchen Univ. (Germany, F.R.); Colorado State Univ., Fort Collins (USA). Dept. of Atmospheric Science). Feb 1987. Contract AC06-76RL01830. 49p. NTIS, PC A03/MF A01; 1; GPO Dep. Order Number DE88013120/JAW.

A series of tethered balloon ascents was made from two sites in Colorado's 700-m-deep Eagle Valley during the temperature inversion breakup period on 4 clear, undisturbed October days. The data were analyzed to determine how the potential temperature and wind fields evolved on a valley cross section following sunrise. The top of the temperature inversion is nearly horizontal at night. After sunrise, the inversion top becomes depressed over the valley center, and maximum warming occurs in the center of the stable core. This occurrence suggests that subsidence, which develops as a response to upslope flow over the sidewalls, is strongest over the valley center. Horizontal temperature gradients are produced in the stable core as a result of the subsidence. Wind systems of different scales (up- and down-slope flows, up- and down-valley flows, and cross-valley flows) develop consistently with the developing horizontal temperature gradients. 18 refs., 9 figs., 3 tabs.

43845 **Modeling the CAPTEX vertical tracer concentration profiles.** Draxler, R.R.; Stunder, B.J.B. (National Oceanic and Atmospheric Administration, Air Resources Laboratory, Silver Spring, Maryland). *Journal of Climate and Applied Meteorology;* **27**: No. 5, 617-625(May 1988).

Perfluorocarbon tracer concentration profiles measured by aircraft 600—900 km downwind of the release locations during CAPTEX are discussed and compared with some model results. In general, the concentrations decreased with height in the upper half of the boundary layer where the aircraft measurements were made. The results of a model sensitivity study suggested that the shape of the profile was primarily due to winds increasing with height and relative position of the sampling with respect to the upwind and downwind edge of the plume. Further modeling studies showed that relatively simple vertical mixing parameterizations could account for the complex vertical plume structure when the model had sufficient vertical resolution. In general, the model performed better with slower winds and corresponding longer transport times.

43846 **Handbook of radon in buildings: Detection, safety, and control.** New York, NY; Hemisphere Publishing (1988). 286p. Hemisphere Publishing, 79 Madison Avenue, New York, NY 10016.

The volume addresses transport mechanisms, reported indoor concentrations, building and meteorological effects on radon concentration, prediction models, health effects, and control technologies. Of special importance is the section on Radon in the Home: A Primer for Homeowners.

5003 Radioactive Materials Monitoring And Transport

REFER ALSO TO CITATION(S) 42725, 42866, 43071, 43199, 43200, 43201, 43212, 43213, 43390, 43828, 43857, 43869, 43958

43847 **(BNL—41234) Evaluation of multiple emission point facilities.** Miltenberger, R.P.; Hull, A.P.; Strachan, S.; Tichler, J. (Brookhaven National Lab., Upton, NY (USA); Lowell Univ., MA (USA). Dept. of Physics). [1988]. Contract AC02-76CH00016. 78p. NTIS, PC A 05; 3; GPO Dep. Order Number DE88012117/JAW.

In 1970, the New York State Department of Environmental Conservation (NYSDEC) assumed responsibility for the environmental aspect of the state's regulatory program for by-product, source, and special nuclear material. The major objective of this study was to provide consultation to NYSDEC and the US NRC to assist NYSDEC in determining if broad-based licensed facilities with multiple emission points were in compliance with NYCRR Part 380. Under this contract, BNL would evaluate a multiple emission point facility, identified by NYSDEC, as a case study. The review would be a nonbinding evaluation of the facility to determine likely dispersion characteristics, compliance with specified re-

lease limits, and implementation of the ALARA philosophy regarding effluent release practices. From the data collected, guidance as to areas of future investigation and the impact of new federal regulations were to be developed. Reported here is the case study for the University of Rochester, Strong Memorial Medical Center and Riverside Campus.

43848 **(SCPRI-RM—12-1987) Monthly results of measurements. December 1987 with supplement related to 1987 last quarter.** (Service Central de Protection contre les Rayonnements Ionisants, 78 - Le Vesinet (France)). Dec 1987. 56p. (In French). NTIS (US Sales Only), PC A04/MF A01. Order Number DE88754064/JAW.

This report of the SCPRI exposes an interpretation of the principal results concerning the routine monitoring of environmental radioactivity in France: atmospheric dusts, rainwater, surface waters, underground water, drinking water, sewage water, food chain (milk, vegetables, fishes), sea water around nuclear plant sites and other sites, sediments. The activities of various radioisotopes are presented in tables. This report exposes also the results of special radiation measurements resulting from the Chernobyl accident.

43849 **Size distributions and growth of natural and Chernobyl-derived submicron aerosols in Tennessee.** Bondietti, E.A.; Brantley, J.N.; Rangarajan, C. (Oak Ridge National Lab., TN (USA); Bhabha Atomic Research Centre, Bombay (India). Div. of Radiological Protection). *Journal of Environmental Radioactivity (London);* 6: No. 2, 99-120(1988).

The median aerodynamic diameters of aerosol-associated SO_4^{2-}, ^{210}Pb, ^{7}Be, and Chernobyl-derived fission products in Tennessee were examined using high-volume cascade impactors. Regardless of season, the 'steady-state' size distributions of SO_4^{2-} shifted to larger sizes than found for either ^{210}Pb or ^{7}Be, and for ^{7}Be sizes showed a weaker seasonal dependency than for either SO_4^{2-} or ^{210}Pb. It is suggested that the size differences are the result of the different spatial distributions of these species in the atmosphere during aerosol formation and growth. Measurements of the size distributions of radioactive aerosols released during the nuclear reactor accident at Chernobyl were made in May and June 1986, and provided rare information on growth rates of aerosols released to the atmosphere over a short time period. A linear growth rate of ~ 0.013 $\mu m\ d^{-1}$ was observed in the lower troposphere after the median diameter had reached ~ 0.4 μm. Chernobyl-derived sup(134,137)Cs was less soluble than ^{7}Be, suggesting the presence of an aerosol core derived from reactor constituents. An analysis of time intervals and trends in both concentrations and isotopic ratios, when compared to Soviet data on the time course of radioactive releases from the damaged reactor, suggested that the large releases which occurred in early May were an important component of the globally transported ^{137}Cs.

5005 Site Resource And Use Studies

REFER ALSO TO CITATION(S) 43825, 43834

43850 **(PNL—6509) The Hanford meteorological data collection system and data base.** Andrews, G.L. (Pacific Northwest Lab., Richland, WA (USA)). Apr 1988. Contract AC06-76RL01830. 42p. NTIS, PC A03;3. Order Number DE88008632/JAW.

The Hanford Meterological Station (HMS) provides meteorological and climatological services to the Department of Energy in Richland and its contractors. On a 24-hour basis, the HMS measures, records, and archives meteorological data collected hourly throughout the year. The current data base consists of five components: wind telemetry stations, doppler acoustic sounders (SODAR), 200-ft towers, 410-ft tower at the HMS, and surface weather observations at the HMS. The wind telemetry station data, 410-ft tower data, and surface weather observation data are archived into yearly ACSII files, and the remaining components are permanently archived in binary from on magnetic tape. The future data base will consist of the same five components, but all components will be permanently archived into yearly ASCII files. Quality assurance computer programs will be written to validate the current data base, and data archival program will be written to improve the archival method that is currently used. 7 refs., 4 figs., 1 tab.

5006 Regulations

REFER ALSO TO CITATION(S) 43043, 43280, 43847

51 ENVIRONMENTAL SCIENCES, TERRESTRIAL

REFER ALSO TO CITATION(S) 43923

5101 Basic Studies

REFER ALSO TO CITATION(S) 42905

43851 (CONF-8708252—, pp 22, Paper 5) **Shift of the climatic zone and boundaries of animals and plants in China during historical times.** Gong, G.; Zhang, P.; Zhang, J. (Institute of Geography, Beijing (China)). Jun 1988. NTIS, PC A09/MF A01. Order Number DE88011540/JAW.

From 2. science team meeting of the United States DOE and Peoples Republic of China academia; Harpers Ferry, WV, USA (26 Aug 1987).

This essay is an effort to discuss the changes of climatic zone in China during historical times and its relationship with animal distribution boundaries, according to archaeological and historical materials as well as plant pollen. First, the shift of climatic zone during historical times, mainly the subtropical zone, will be discussed based on all available information excluding that of animals. Then, animal distribution, mainly that of the wild elephant, will be contrasted. Finally, the influences made by natural changes of climate to animal boundaries will be isolated from those resulting from human activities.

43852 **(IEN-DIAPQ—08/87) Radiocrystallographic study of titanites from Xerem, Rio de Janeiro.** Baptista, A.; Baptista, N.R. (Instituto de Engenharia Nuclear, Rio de Janeiro (Brazil)). 1987. 12p. (In Portuguese). NTIS (US Sales Only), PC A03/MF A01. Order Number DE88703538/JAW.

The conclusions of the radiocrystallographic studies in titanite crystals - CaTi[SiO/sub 4/] (0,0H,F) from two rocks with different petrogenesis, from Xerem, Rio de Janeiro State are described. The rocks was granite and nepheline-gneiss and the Spetrochemical analysis showed different compositions to crystals from each one of the rocks. This different composition was eough to development of comparative study using optical determination and petrographic analysis. (C.D.G.).

5102 Chemicals Monitoring And Transport

REFER ALSO TO CITATION(S) 42620, 42627, 43685, 43837, 43842, 43974, 43975

43853 (CONF-871075—Vol.1-Pt.3, pp 111-127) **Treatment of chemical waste and contaminated soils containing halogenated compounds and various metals with a potassium-polyethylene glycol reagent.** Tiernan, T.O.; Wagel, D.J.; VanNess, G.F.; Garrett, J.H.; Solch, J.G.; Harden, L.; Rogers, C. (Wright State Univ., Dayton, OH (USA)). 1987. NTIS, PC A18/MF A01. Order Number DE88007805/JAW.

From 3. Oak Ridge model conference on waste problems; Oak Ridge, TN, USA (13 Oct 1987).

The objectives of this study are to: determine the efficacy of the KPEG reagent for destroying tetrachlorinated and higher chlorinated PCDD and PCDF contained in a pentachlorophenol (PCP) - oil wood treatment waste and soil contaminated with this waste by laboratory tests; to optimize reaction conditions in the lab tests to maximize the efficiency of the destruction and obtain data useful for engineering scale-up of the laboratory-scale process; to evaluate the KPEG process in field tests on hazardous wastes at

several US sites and to develop a new prototype reactor for future field treatment applications.

43854 (CONF-871075—Vol.1-Pt.3, pp 431-433) **Soil-gas screening: its theory and applications to hazardous waste site investigations.** Leis, W.M.; Preslo, L.M.; Pavlick, R. (Roy F. Weston, Inc., Concord, CA (USA)). 1987. NTIS, PC A18/MF A01. Order Number DE88007805/JAW.

From 3. Oak Ridge model conference on waste problems; Oak Ridge, TN, USA (13 Oct 1987).

Soil-gas screening, if conducted properly is a very effective and comparatively inexpensive technique for the following applications: source-area identification; on-site vs. off-site sources; plume-tracking of chemicals within the ground water; migration of landfill gases; optimize subsequent monitoring points. This paper discusses the theory behind soil-gas screening, its applications at various sites, and its limitations depending on site conditions.

43855 (CONF-880741—4) **Modeling ground water transport of dissolved gasoline.** Yin, S.C.L. (Argonne National Lab., IL (USA)). 1988. Contract W-31-109-ENG-38. 8p. NTIS, PC A02/MF A01; 1; GPO Dep. Order Number DE88011981/JAW.

From Joint CSCE-ASCE conference on environmental engineering; Vancouver, Canada (13 Jul 1988).

A solute transport model was used to simulate aquifer restoration processes for ground water contaminated by dissolved gasoline. The simulation results were used to evaluate the feasibility and effectiveness of aquifer restoration by pumping out the contaminated water. The aquifer restoration process consists of a single well, located at the center of the contaminated area, that pumps the ground water at constant rates of 400, 50, and 5 gpm for three aquifers with hydraulic conductivities of 5000, 500, and 50 gpd/ft^2, respectively. The pumping rates were selected so that the maximum well drawdown, after 20 years of pumping, in all three cases is about one half of the aquifer thickness. The modeling results indicate that the time of pumping required to reduce concentrations of benzene and xylene to acceptable levels is likely to be many years. Even for the case with the highest hydraulic conductivity, it would take 4 and 12 years, respectively, to reduce benzene and xylene concentrations to 10 ppb. In general, the pumping periods required are sensitive to hydraulic conductivity of the aquifer and retardation factors of the hydrocarbons.

43856 (CONF-8805103—4) **Recent trends in hazardous waste management: removal actions.** MacDonell, M.M.; Peterson, J.M.; Beskid, N.J. (Argonne National Lab., IL (USA)). 1988. Contract W-31-109-ENG-38. 12p. NTIS, PC A03/MF A01; 1; GPO Dep. Order Number DE88012068/JAW.

From Hazardous material spills conference; Chicago, IL, USA (16 May 1988).

In response to the release or threat of release of hazardous substances from contaminated sites across the United States, there has been a recent trend toward implementing removal actions. Removal actions may be conducted as part of cleanup activities at waste sites ranging from illegal dump sites to sites on the national Priorities List of the US Environmental Protection Agency (EPA). The scope of removal actions can range from very limited actions to full-scale excavation and treatment operations, depending on the nature of the needed response. In all cases, the removal must be consistent with the final remedial action at the site and must contribute to the efficient performance of that remedial action. Historically, removal actions have been carried out in response to time-critical emergencies where it can be shown that there exists an imminent and substantial danger to public health or the environment. However, recent guidance from the EPA has supported implementation of removal actions at sites that do not pose such an immediate threat. Non-time-critical actions are being taken, where appropriate, to effect cleanup in a more cost-effective and timely manner than would otherwise be possible (e.g., if tied to the record of decision for the final remedial action). The increased emphasis on removal actions is reflected in recent legislation, in regulations that are currently being drafted, and in EPA directives. This paper discusses the relationship of removal actions to the Comprehensive Environmental Response, Compensation, and Liability Act of 1980 the Superfund Amendments and Reauthorization Act of 1986, the current and proposed revisions of the National Oil and Hazardous Substances Pollution Contingency Plan, and recent EPA policy and directives.

43857 (DPSPU—88-30-1-Vol.1) **Savannah River Plant environmental report. Annual report for 1987. Volume I.** Mikol, S.C.; Burckhalter, L.T.; Todd, J.L.; Martin, D.K. (Du Pont de Nemours (E.I.) and Co., Aiken, SC (USA). Savannah River Lab.). 1987. Contract AC09-76SR00001. 189p. NTIS, PC A09/MF A01; 1; GPO Dep. Order Number DE88012423/JAW.

This 1987 report contains monitoring data from routine radiological and nonradiological environmental surveillance activities, summaries of environmental protection programs in progress, a summary of National Environmental Policy Act (NEPA) activities, and a listing of environmental permits issued by regulatory agencies and their status. The environmental surveillance activities at and in the vicinity of SRP comprise one of the most comprehensive and extensive environmental monitoring programs in the United States.

43858 (WHC-EP—0021) **Interim hydrogeologic characterization report and ground water monitoring system for the nonradioactive dangerous waste landfill, Hanford Site, Washington.** Weekes, D.C.; Luttrell, S.P.; Fuchs, M.R. (Westinghouse Hanford Co., Richland, WA (USA)). Oct 1987. Contract AC06-87RL10930. 271p. NTIS, PC A 12; 3; GPO Dep. Order Number DE88011910/JAW.

This report documents the hydrogeologic characterization and installation of ground water monitoring wells at the Nonradioactive Dangerous Waste (NRDW) Landfill. A total of nine wells were installed to determine characteristics such as ground water quality, hydraulic conductivity, and continuity of hydrostratigraphic units. Seven of these wells compose a detection level ground water monitoring system that meets the requirements for interim status ground water monitoring under 40 CFR 265, Subpart F. Ground water flow is generally west to east across the NRDW Landfill, and the gradient is very small (about 0.1 ft/1300 ft). The uppermost section of the aquifer is unconfined and highly transmissive. Transmissivity values range from approximately 100,000 to 300,000 ft^2/d. The hydraulic conductivity ranges from 1700 to 5000 ft/d, based on a saturated thickness of 60 ft. A relatively thin clayey silt unit, of low-permeability, is laterally continuous under the NRDW Landfill and acts as the base of the aquifer for the purpose of monitoring potential vertical contaminant migration. Results from water samples collected from monitoring wells were compared with interim primary drinking water standards, and no constituent was found to exceed these standards.

5103 Radioactive Materials Monitoring And Transport

REFER ALSO TO CITATION(S) 42725, 42768, 42769, 42844, 42865, 43213, 43248, 43842, 43848, 43857, 43964

43859 (CNR-IFA—86-38) **Chernobylsk accident: radioactivity measurement of airborn particulate in the AM/CNR network.** Colacino, M.; Favale, B.; Passamonti, V.; Baldi, M.; Dietrich, E. (Consiglio Nazionale delle Ricerche, Rome (Italy). Ist. di Fisica dell'Atmosfera). 1986. 112p. (In Italian). NTIS (US Sales Only), PC A06/MF A01. Order Number DE88701718/JAW.

Results are presented of the radioactivity measurements performed on samples of airborne particulates taken at the station of the AM/CNR network after the Chernobylsk accident. In particular for the 16 operating stations are reported tables and trends referred to the beta total measurements performed on two samples per day per station and the activity of some gamma emitting radionuclides deriving from the analysis made on concentrations of filters referred to North-Central and Southrn Italy plus Islands. The presentation of data is preceded by a short description of the AM/CNR network and the sampling system as well as the methodology of total beta measurement and gamma analysis.

43860 (IAEA-SR—110(bk.), pp 127-141) **Ion exchange properties of three Brazilian soils with high clay mineral content and their use in radionuclide absorption.** Miekeley, N.; Albuquerque, P.C.W. de. (Pontificia Univ. Catolica do Rio de Janeiro (Brazil). Dept. de Quimica). 1986. NTIS (US Sales Only), PC A99/MF A01. Order Number DE88702505/JAW. (CONF-861065—).

From Seminar on management options for low and intermediate level wastes in Latin America; Rio de Janeiro, Brazil (13 Oct 1986).

The ion exchange properties of three different soils containing illite, montmorillonite of vermiculite as principle adsorbing material have been studied by radioactive tracer methods. Ion exchange isotherms confirmed enhanced selectivity of these soils for Ce, Sr and Cs, which was highest for Ce in illite and for Cs in bentonite. Ion and isotopic exchange rates have been measured, showing that a variable fraction of these cations remained kinetically fixed in the soils, depending on the nature of the exchangeable ions. Bentonite soil was studied in column operations, aiming at Cs-137 decontamination of tap water, and revealed as a promissing material for this purpose.

43861 (IAEA-SR—110(bk.), pp 296-305) **Criteria and evaluation of shallow land burial sites.** Chandra, U. (Instituto de Pesquisas Energeticas e Nucleares, Sao Paulo (Brazil)). 1986. NTIS (US Sales Only), PC A99/MF A01. Order Number DE88702505/JAW. (CONF-861065—).

From Seminar on management options for low and intermediate level wastes in Latin America; Rio de Janeiro, Brazil (13 Oct 1986).

The criteria for shallow ground disposal of radioactive wastes as developed by Nuclear Regulatory Commission-US and International Atomic Energy Agency are discussed. Emphasis has been given to: elaboration of various basic components of a national Strategy for radioactive waste disposal; development of technical requirements; environmental standards, consensus among scientific community and public confidence. Aspects of site selection, evaluationcharacterization and site suitability are dealt with. Some results of characterization of a site for tempory storage of low level solid radioactive wastes in Instituto de Pesquisas Energeticas e Nucleares-IPEN-CNENSao Paulo are described. The methods used for hydrological characterization include use of artificial tritium for unsaturated zone and radioactive tracers like I-131, Cr^{51} Cl_b, Cr^{51} EDTA, Br^{82} for the saturated zone.

43862 (IC—87/419) **Microphysics of the Saharan dust and its implications on climate.** Kalu, A.E. (International Centre for Theoretical Physics, Trieste (Italy)). Dec 1987. 44p. NTIS (US Sales Only), PC A03/MF A01. Order Number DE88703525/JAW.

A strong influence of Saharan dust plumes on the microphysics of cumulus clouds, especially along their long-distance transport trajectories into cloudy regions of the world, has been discussed and illustrated. This climate-related influence is primarily based on the observed anhydrous non-hygroscopic property of the Saharan dust, otherwise known as the Harmattan dust haze in Nigeria. An observational feature of the dust-cloud interaction which is strongly climate-related is the rapid clearance of cumulus clouds on arrival of a dust plume. This is because aeolian dust particles and water droplets cannot coexist comfortably. A useful practical application of this influence of the dust on clouds by means of atmospheric teleconnection principles for fine-weather prediction in cloudy remote regions seasonally affected by dust plumes from the Sahara, has therefore been suggested. (author). 37 refs, 6 figs, 3 tabs, 3 plates.

43863 (INIS-mf—11109) **Final report on the radioactivity of ground-, surface and waste waters, of the soil and vegetation in the control area of the research reactor Seibersdorf for 1986.** (Oesterreichisches Forschungszentrum Seibersdorf G.m.b.H. Strahlenschutz-Kontrollabteilung). May 1987. 28p. (In German). NTIS (US Sales Only), PC A03/MF A01. Order Number DE88701748/JAW.

The measurements did not show any effects or limit transgression due to the operation of the Astra Reactor. On the other hand the effects of the Chernobyl accident were clearly seen in May and June 1986. 6 figs., 6 tabs. (qui).

43864 (JAERI-M—88-038) **Measurement of distribution coefficients of plutonium between subsurface soils and simulated groundwater.** Senoo, Muneaki; Shirahashi, Koichi; Sakamoto, Yoshiaki; Konishi, Masao; Moriyama, Noboru. (Japan Atomic Energy Research Inst., Tokyo). Feb 1988. 14p. (In Japanese). NTIS (US Sales Only), PC A03/MF A01. Order Number DE88753432/JAW.

Distribution coefficients of plutonium were measured by batch method between simulated groundwater and mortar or subsurface soils (loam, medium sand, weathered tuff) which were sampled at ROKKASHO-MURA KAMIKITA-GUN AOMORI Pref. in order to evaluate whether the data are reasonable or not which are to be used for safety assessment of shallowland disposal of low level radioactive wastes. Column experiment was also carried out to investigate the releasing behavior of plutonium from plutonium adsorbed mortar into groundwater. The results obtained from batch experiment showed that the distribution coefficients were of the order of 10^3 mlg for loam, medium sand and weathered tuff and of 10^4 mlg for mortar. Plutonium released from the mortar was scarcely detected. This result is in good accord with expectations based on the measured distribution coefficient of 10^4 mlg for mortar by batch method.

43865 (KURRI-TR—290, pp 1-6) **Oxidation of tritium gas by soil.** Ichimasa, Yusuke; Ichimasa, Michiko; Akita, Yasukazu. (Ibaraki Univ., Mito (Japan). Faculty of Science). Jun 1987. (In Japanese). NTIS (US Sales Only), PC A05/MF A01. Order Number DE88780086/JAW. (CONF-8607368—).

From Short-term conference on biological transformation of radionuclides in the environment and dose assessment; Kumatori, Japan (23 Jul 1986).

The oxidation activity of tritium gas in different soils in Ibaraki and Miyazaki prefecture was investigated. Tritium gas was rapidly oxidised in the soils under aerobic and anerobic conditions. The rate constant of the oxidation of tritium gas in soil was varied with the depth of soil, temperature and soil water content. In the lower sections (5 - 10 cm and 10 - 15 cm in depth) of the soil, the oxidation rate of tritium gas was one fourth and one eight, respectively that of the top section (0 - 5 cm). The oxidation occurred over a broad temperature range from 0 to 75 deg C. The tritium gas oxidation activity in the upper soil (0 - 5 cm) under anaerobic condition (N_2) was somewhat lower than that under aerobic condition, but below this depth both activities were generally the same. The tritium gas oxidation activity of soil was completely destroyed by dry sterilization and autoclaving. The tritium gas oxidation activity in soil under aerobic condition was slightly high comparing with those of feces of the rat, monkey or man.

43866 (KURRI-TR—290, pp 23-31) **Transuranium elements in organic chemical forms.** Sakanoue, Masanobu; Yamamoto, Masayoshi. (Kanazawa Univ. (Japan). Faculty of Science). Jun 1987. (In Japanese). NTIS (US Sales Only), PC A05/MF A01. Order Number DE88780086/JAW. (CONF-8607368—).

From Short-term conference on biological transformation of radionuclides in the environment and dose assessment; Kumatori, Japan (23 Jul 1986).

It is very important to achive an understanding what role organic matter plays in the behavior of transuranium elements in the environment. This paper reports the studies on characteristics of fallout Pu and Am in soil closely related to soil organic matter, and interaction of humic acid and Am (III) in aqueous solution. From the results obtained, it was suggested that the humic acids had strong interaction with transuranium elements, but such soluble complexes were removed soon from the solution by coagulation and sorption on soil.

43867 (KURRI-TR—290, pp 32-45) **Concentration of radioactive nuclides in soil and geology.** Tsujimoto, Tadashi. (Kyoto Univ., Kumatori, Osaka (Japan). Research Reactor Inst.). Jun 1987. (In Japanese). NTIS (US Sales Only), PC A05/MF A01. Order Number DE88780086/JAW. (CONF-8607368—).

From Short-term conference on biological transformation of radionuclides in the environment and dose assessment; Kumatori, Japan (23 Jul 1986).

Measurements of radiation dose rates and concentration of radioactive nuclides in soil were carried out on Tsuruga-Mihama region which is composed of younger granites, Ohii region which is composed of ultra basic rocks and intrusive rocks, and Takahama region which is composed of shales and sand stones belonging to later Triassic period of Mesozoic era. The results of measurement at 1 meter above ground surface showed that the radiation dose rates at Ohii and Takahama regions were so low as 1 ~ 9 μRh against very high dose rate of 12 ~ 24 μRh at Tsuruga-Mihama region. Nuclides of tritanium series are thought to affect remarkably to the contributions of radiation dose rates. Classification of radioactive nuclides in soil following the concentration components was attempted. ^{40}K occupied more than 88 %, nuclides of tritium showed subsequent abundance or 6 ~ 10 %, and the least abundance of 2 ~ 4 % was shown by the nuclides of uranium series. The tendencies of concentration of radioactive nuclides showed similarity with the tendenciess of country rocks.

43868 (KURRI-TR—290, pp 58-62) **Physico-chemical behavior of radionuclides and their biological transformation. Especially on the interaction with coastal sediments.** Kimura, Yuichiro; Ogawa, Yoshihiro; Honda, Yoshihide. (Kinki Univ., Higashi-Osaka, Osaka (Japan). Faculty of Science and Technology). Jun 1987. (In Japanese). NTIS (US Sales Only), PC A05/MF A01. Order Number DE88780086/JAW. (CONF-8607368—).

From Short-term conference on biological transformation of radionuclides in the environment and dose assessment; Kumatori, Japan (23 Jul 1986).

The sorption and desorption characteristics for radiocobalt (^{57}Co) in both chloride and cyanocobalamin and americium (^{241}Am) in nitrate were studied in laboratory sediment-seawater systems. The distribution coefficients(Kds) and their time course in the sorption experiments were varied with the radionuclides in different chemical forms, sediment particle sizes and their elemental compositions. The magnitude of the Kd values for the radionuclides at apparent equilibrium was in a following order : ^{241}Am in nitrate > ^{57}Co in chloride > ^{57}Co in cyanocobalamin. The desorption rates of radiocobalt were also varied with different chemical forms and by the addition of marine bactrial cells though any desorption of ^{241}Am was scarcely observed.

43869 **(KURRI-TR—290) Proceedings of the short-term conference on biological transformation of radionuclides in the environment and dose assessment.** Honda, Yoshihide; Katsurayama, Kousuke; Tsujimoto, Tadashi (eds.). (Kyoto Univ., Kumatori, Osaka (Japan). Research Reactor Inst.). Jun 1987. vp. (In Japanese). (CONF-8607368—). NTIS (US Sales Only), PC A05/MF A01. Order Number DE88780086/JAW.

From Short-term conference on biological transformation of radionuclides in the environment and dose assessment; Kumatori, Japan (23 Jul 1986).

Individual papers in these proceedings were abstracted separately.

5105 Site Resource And Use Studies

REFER ALSO TO CITATION(S) 42905

43870 **(CONF-8805149—1) Ecosystem restoration and rehabilitation: a landscape systems approach.** Krummel, J.R. (Argonne National Lab., IL (USA)). 1988. Contract W-31-109-ENG-38. 9p. NTIS, PC A02/MF A01; 1; GPO Dep. Order Number DE88012010/JAW.

From Ecosystem restoration and rehabilitation conference; Paris, France (18 May 1988).

Desertification, erosion, movement of contaminants from land surfaces to aquatic ecosystems, elevated atmospheric levels of carbon dioxide, loss of biological diversity, and deforestation all are functions of land cover changes associated with natural resource exploitation. These disturbances alter the spatial pattern of ecosystem processes that are dynamic components of landscape systems. Recent developments in landscape ecology demonstrate the need to explicitly incorporate pattern-process interactions when analyzing the response of natural systems to disturbances over large geographic areas. Since degraded ecosystems are both local and regional problems, it will be necessary to incorporate information on land cover heterogeneity when addressing the mitigation options and management techniques needed to rehabilitate these land areas.

43871 (DOE/EV/00703—T1-Vol.2, pp 1-9) **Marine benthic algae of Enewetak Atoll.** Tsuda, R.T. (Univ. of Guam, Mangilao). 1987. NTIS, PC A15/MF A01. Order Number DE87006111/JAW.

In The natural history of Enewetak Atoll: Volume 2, Biogeography and systematics.

The authors present knowledge of the floristics and ecology of the marine benthic algae on Pacific atolls is based primarily on studies conducted on Enewetak Atoll. There are more species of marine benthic algae known from this atoll than are known from any other Indo-Pacific atoll. On the basis of the papers cited above, 238 species (106 genera) of marine benthic algae are known from Enewetak Atoll: Cyanophyta (16 species), Chlorophyta (89 species), Phaeophyta (24 species), and Rhodophyta (109 species). Nine of the species were described as new with the Enewetak specimens serving as holotypes. It is interesting to note that 40 species (nine Chlorophyta, three Phaeophyta, and 28 Rhodophyta) or 16% of the species reported from Enewetak represent the only collections known from the geographic region of Micronesia. It is unlikely that these species are unique to Enewetak; further intensive collections from other areas in Micronesia will no doubt provide additional records.

43872 (DOE/EV/00703—T1-Vol.2, pp 11-15) **Fungi of Enewetak Atoll.** Dunn, P.H.; Reynolds, D. (Dept. of Agriculture Forest Service, Riverside, CA (USA)). 1987. NTIS, PC A15/MF A01. Order Number DE87006111/JAW.

In The natural history of Enewetak Atoll: Volume 2, Biogeography and systematics.

The microfungi of Enewetak Atoll are typical tropical forms and are not restricted to that atoll. Because of the extreme isolation of Enewetak, however, it seems likely that the fungi there are indigenous to the atoll and are not introductions by man. Whether the origin is terrestrial or from the beaches remains a question. The mycological data from Enewetak Atoll reflect two principles of fungal biogeography: similar regions have similar biotas, and distributions data are often due to bias collection activity of mycologists.

43873 (DOE/EV/00703—T1-Vol.2, pp 17-35) **Natural history of terrestrial vascular plants of Enewetak Atoll.** Lamberson, J.O. (Environmental Protection Agency, Newport, OR (USA)). 1987. NTIS, PC A15/MF A01. Order Number DE87006111/JAW.

In The natural history of Enewetak Atoll: Volume 2, Biogeography and systematics.

Enewetak Atoll has evolved over geological time from a raised limestone island environment supporting mangrove swamps and an upland mixed forest to a low coral sand island habitat with typical strand vegetation. The 128 species of plants recorded from the atoll include many introduced weeds and ornamental or food plants, although 43% of the flora is considered to be indigenous to Micronesia. The dry, windy season from November through April causes many of the plants to drop some or all of their leaves or to die back completely. Summer-June through September - is the season of maximum plant growth and more flower and seed production. The effects of World War II and post-war military activity, the nuclear test program from 1948 to 1958, and the radiological cleanup and rehabilitation for the return of the people of Enewetak have been significant with regard to the vegetation. Many species were accidentally or intentionally introduced to the atoll, and some species have disappeared. The vegetation was greatly altered because of destruction of habitat with removal of soil and nutrients and exposure of the plants to salt spray and drying winds. Several collections and studies of the flora have been reported. This chapter describes stages in the succession of the vegetation following disturbance. The vegetation of the islands during the period 1975 to 1977 is also described in some detail.

43874 (DOE/EV/00703—T1-Vol.2, pp 37-47) **Recent Foraminifera and nonplanktonic protozoans.** Chave, E.H.; Devaney, D.M. (Univ. of Hawaii, Honolulu (USA)). 1987. NTIS, PC A15/MF A01. Order Number DE87006111/JAW.

In The natural history of Enewetak Atoll: Volume 2, Biogeography and systematics.

An overview is presented of foraminiferal fauna and nonplanktonic protozoans at Eniwetok from 1946-1981. A checklist is presented which identifies 280 species.

43875 (DOE/EV/00703—T1-Vol.2, pp 49-51) **Porifera of Enewetak Atoll.** Devaney, D.M. (Bernice P. Bishop Museum, Honolulu, HI (USA)). 1987. NTIS, PC A15/MF A01. Order Number DE87006111/JAW.

In The natural history of Enewetak Atoll: Volume 2, Biogeography and systematics.

The first sponges reported from Enewetak were based on collections made between 1946 and 1948 from a number of tropical Pacific areas (de Laubenfels, 1954). The Pacific Science Board of the National Research Council sponsored the collections project. Six of the 13 species recorded from Enewetak were collected by dredging near the center of the lagoon (8 km north of the south anchorage; approximately 11° 29' N, 165° 15' E, de Laubenfels, 1954) at a depth of 35 m. Another species came from the reef flat, and six were from unrecorded localities. Three new species were recorded from Enewetak, but only one (Lissodendoryx calypta) was unique to that atoll. A classification checklist of Porifera at Eniwetok is included.

43876 (DOE/EV/00703—T1-Vol.2, pp 53-62) **Sea anemones of Enewetak Atoll.** Cutress, C.E.; Arneson, A.C. (Univ. of Puerto Rico, Mayagueez). 1987. NTIS, PC A15/MF A01. Order Number DE87006111/JAW.

In The natural history of Enewetak Atoll: Volume 2, Biogeography and systematics.

The sea anemones covered in this chapter were collected and/or photographed in part by Cutress during May and June 1955 and in part by Arneson from September through November 1980. Collection records are shown at the end of the chapter. Most identifications were made from preserved specimens, but a few were made from photographs alone. Available photographs of Phymanthus strandesi and Physobrachia douglasi are inadequate. Heterodactyla hemprichi was not photographed. No published taxonomic work on Enewetak sea anemones exists. Dunn (1981), in a revision of the clown-fish anemones, refers by catalog numbers to preserved specimens from Enewetak which she examined. Allen (1972) refers to and illustrates seven species of host anemones that he observed at Enewetak from 1968 to 1971. Josephson (1966) made physiological observations on Calliactis polypus, and Johannes et al. (1972) refer to an unidentified digging anemone subsequently identified as Actinodendron plumosum. A checklist is provided of Enewetak sea anemones.

43877 (DOE/EV/00703—T1-Vol.2, pp 63-65) **Octocorallia of Enewetak Atoll.** 1987. NTIS, PC A15/MF A01. Order Number DE87006111/JAW.

In The natural history of Enewetak Atoll: Volume 2, Biogeography and systematics.

The Alcyonaceans are the most numerous octocorals represented at Eniwetok with approximately 20 species now known. A checklist of octocorallia of Eniwetok Atoll is included.

43878 (DOE/EV/00703—T1-Vol.2, pp 67-76) **Scleractinia (Stony Corals) of Enewetak Atoll.** Devaney, D.M.; Lang, J.C. (B. P. Bishop Museum, Honolulu, HI (USA)). 1987. NTIS, PC A15/MF A01. Order Number DE87006111/JAW.

In The natural history of Enewetak Atoll: Volume 2, Biogeography and systematics.

Approximately 170 species in 54 genera have been identified among the 2500 stony coral specimens which were collected from 28 sites around Eniwetok Atoll. Although the field guide is still in preparation, a provisional checklist of scleractinian corals now believed to occur at Eniwetok is presented.

43879 (DOE/EV/00703—T1-Vol.2, pp 77-84) **Brachiopods of Enewetak Atoll.** Grant, R.E. (National Museum of Natural History, Washington, DC (USA)). 1987. NTIS, PC A15/MF A01. Order Number DE87006111/JAW.

In The natural history of Enewetak Atoll: Volume 2, Biogeography and systematics.

On Eniwetok the brachiopods are small and inconspicuous, living in cryptic habitats under the shade of coral fronds, in recesses in the reef, or on lagoon pinnacles. An attempt is made to summarize the ecology of the brachiopods and the most conspicuous species are illustrated. A checklist is included of Eniwetok brachiopods.

43880 (DOE/EV/00703—T1-Vol.2, pp 85-92) **Reef-dwelling bryozoans of Enewetak Atoll.** Cuffey, R.J.; Cox, R.S. (Pennsylvania State Univ., University Park (USA)). 1987. NTIS, PC A15/MF A01. Order Number DE87006111/JAW.

In The natural history of Enewetak Atoll; Volume 2, Biogeography and systematics.

The goals of this report are to list the bryozoans found on the modern reefs of Enewetak Atoll, illustrate the most conspicuous species, indicate their biogeographic implications, and summarize their ecology (particularly ecozonal distributions and constructional roles).

43881 (DOE/EV/00703—T1-Vol.2, pp 93-94) **Sipunculans and echiurans of Enewetak Atoll.** Devaney, D.M. (Bernice P. Bishop Museum, Honolulu, HI (USA)). 1987. NTIS, PC A15/MF A01. Order Number DE87006111/JAW.

In The natural history of Enewetak Atoll: Volume 2, Biogeography and systematics.

At the present time at least 10 identified species of sipunculans are considered to occur at Eniwetok. Echiurans are previously unrecorded from Eniwetok or the other Marshall Islands. However, the bifurcate-tipped proboscis of a bonellid echiruan has been observed in the shallower waters of Eniwetok lagoon extending from beneath attached coral reef outcrops. A checklist of Eniwetok Sipuncula and Echiura is presented.

43882 (DOE/EV/00703—T1-Vol.2, pp 95-96) **Platyhelminthes, Nemertea, and Nematoda of Enewetak Atoll.** Devaney, D.M. (Bernice P. Bishop Museum, Honolulu, HI (USA)). 1987. NTIS, PC A15/MF A01. Order Number DE87006111/JAW.

In The natural history of Enewetak Atoll: Volume 2, Biogeography and systematics.

Except for some reports on parasitic nematodes and platyhelminthes in oysters, fish, and porpoises, little has been written about the platyhelminthes, nemertina, and nematoda of Enewetak Atoll. Little has been done on free-living nemertines or nematodes, although both groups must be abundant. The checklist is presented which gives the taxonomics of these species.

43883 (DOE/EV/00703—T1-Vol.2, pp 97-103) **Polychaetes of Enewetak Atoll.** Devaney, D.M.; Bailey-Brock, J.H. (Bernice P. Bishop Museum, Honolulu, HI (USA)). 1987. NTIS, PC A15/MF A01. Order Number DE87006111/JAW.

In The natural history of Enewetak Atoll: Volume 2, Biogeography and systematics.

An attempt is made to list the polychaetes recorded on Eniwetok. A number of identified species are discussed in relation to habitat, population density and location. A total of 132 polychaete species have been identified on Eniwetok.

43884 (DOE/EV/00703—T1-Vol.2, pp 105-147) **Mollusca of Enewetak Atoll.** Kay, E.A.; Johnson, S. (Univ. of Hawaii, Honolulu (USA)). 1987. NTIS, PC A15/MF A01. Order Number DE87006111/JAW.

In The natural history of Enewetak Atoll: Volume 2, Biogeography and systematics.

This report provides a check list of all the mollusks found on Eniwetok, both living and fossils. The most conspicuous species are illustrated and their ecology is summarized.

43885 (DOE/EV/00703—T1-Vol.2, pp 147-177) **Insects and allies (Arthropoda) of Enewetak Atoll.** Samuelson, G.A.; Nishida, G.M. (Bernice P. Bishop Museum, Honolulu, HI (USA)). 1987. NTIS, PC A15/MF A01. Order Number DE87006111/JAW.

In The natural history of Enewetak Atoll: Volume 2, Biogeography and systematics.

Insects and related terrestrial arthropods of Enewetak Atoll remain inadequately investigated. Woodbury (1962) included an inventory of arthropods known from the atoll in which he indicated that ectoparasites were taken from 10 species of birds; altogether he reported 45 species or subspecies authentically recorded from the atoll. The present list increases the number of arthropods to 191 species (or subspecies) and must still be considered preliminary, as records are lacking for many expected groups. Before this list can be completed, further collections and their study are required, especially of the soil fauna, ectoparasites and nidicoles of reptiles, birds, and rodents, and the forms associated with humans and human habitations. A checklist of Enewetak insects and related arthropods is provided.

43886 (DOE/EV/00703—T1-Vol.2, pp 179-180) **Pycnogonida of Enewetak Atoll.** Child, C.A. (Smithsonian Institution, Washington, DC (USA)). 1987. NTIS, PC A15/MF A01. Order Number DE87006111/JAW.

In The natural history of Enewetak Atoll: Volume 2, Biogeography and systematics.

Pycnogonids are very scarce on Eniwetok with only five species in four genera known there. A sixth, Nymphon micronesicum is also known from Bikini. This is a very small fauncle when considering the great diversity of this class of arthropods in the oceans of the world. A checklist is included of Pycnogonida of Eniwetok Atoll.

43887 (DOE/EV/00703—T1-Vol.2, pp 181-190) **Stomatopod crustacea of Enewetak Atoll.** Reaka, M.L.; Manning, R.B. (Univ. of Maryland, College Park (USA)). 1987. NTIS, PC A15/MF A01. Order Number DE87006111/JAW.

In The natural history of Enewetak Atoll: Volume 2, Biogeography and systematics.

This study provides a checklist and discusses the biogeographic relationships of the 12 species of Stomatopoda (mantis shrimps) now known to occur on Enewetak Atoll. Five species are widely distributed throughout the Indo-West Pacific region, and three species have somewhat more restricted ranges in the Indo-West Pacific and Indian Ocean. Four species are endemic to the Central Pacific (two to Enewetak), and three taxa need further taxonomic investigation, which may demonstrate further endemism. Stomatopods from Enewetak are dwarfed in body size compared to their mainland relatives. Small size has strong consequences for life history and evolutionary patterns in stomatopods, and in particular is likely to generate endemism. They provide information on the color patterns of the stomatopods from Enewetak, showing which traits are the most reliable indicators of species identity for taxonomic and field research and which traits are most likely to be influenced by body size, sex, or habitat. Several anomalies in usually invariant color traits are found in stomatopods from Aomon Island, which was closer to sources of radiation from atomic testing than more southern islands in the atoll. They also summarize what is known about the habitat and fighting behavior of the coral-dwelling mantis shrimps from Enewetak. for each of the above topics, they identify or discuss all previous literature on the stomatopods of Enewetak.

43888 (DOE/EV/00703—T1-Vol.2, pp 191-195) **Cirripedia of Enewetak Atoll.** Titgen, R.H. (Bernice P. Bishop Museum, Honolulu, HI (USA)). 1987. NTIS, PC A15/MF A01. Order Number DE87006111/JAW.

In The natural history of Enewetak Atoll: Volume 2, Biogeography and systematics.

There has been relatively little research done on barnacles at Eniwetok. Only nine species have been reported from there. A checklist of barnacles found at Eniwetok Atoll is presented. The list also includes species that probably occur there because so few of the species that may occur there have been reported.

43889 (DOE/EV/00703—T1-Vol.2, pp 197-201) **Nonplanktonic copepoda of Enewetak Atoll.** Devaney, D.M. (Bernice P. Bishop Museum, Honolulu, HI (USA)). 1987. NTIS, PC A15/MF A01. Order Number DE87006111/JAW.

In The natural history of Enewetak Atoll: Volume 2, Biogeography and systematics.

The copepod fauna of Enewetak is based on studies carried out on symbiotic (commensal and parasitic) species as well as those found as part of the plankton community. A checklist of copepod fauna is included.

43890 (DOE/EV/00703—T1-Vol.2, pp 203-216) **Lagoon plankton of Enewetak Atoll.** Gerber, R.P. (St. Joseph's College, Windham, ME (USA)). 1987. NTIS, PC A15/MF A01. Order Number DE87006111/JAW.

In The natural history of Enewetak Atoll: Volume 2, Biogeography and systematics.

Studies on the species composition of lagoon zooplankton at Enewetak Lagoon and nearby atolls have for the most part focused on the holoplanktonic organisms, forms that are permanently planktonic all of their lives; these forms are the main attention of this chapter. Because information is lacking on the life history of many of the species mentioned, some meroplanktonic forms - organisms that are temporarily planktonic - are no doubt included in this checklist. A variety of sampling methods have been used to collect the zooplankton, and each method has its inherent advantages and disadvantages. In a sense it is perhaps fortunate that no one method is best to sample the various types of zooplankton. One important aspect lacking in the data is adequate seasonal samplings to provide information on how species composition and abundance change over time. Whereas most of the lagoon plankton studies were based on samples collected over a few days in one season, the present author has sampled more extensively, during two winter periods and one summer period.

43891 (DOE/EV/00703—T1-Vol.2, pp 217-219) **Ostracoda (Myodocopina) of Enewetak Atoll.** Kornicker, L.S. (Smithsonian Institution, Washington, DC (USA)). 1987. NTIS, PC A15/MF A01. Order Number DE87006111/JAW.

In The natural history of Enewetak Atoll: Volume 2, Biogeography and systematics.

Ostracods in the superorder Mydocopa, excluding the planktonic suborder Halocypridina, which is outside the scope of the present report, have not previously been reported from Micronesia. A comprehensive checklist of Ostracoda from southeast Asia is concerned with the area between 25°N and 11°S latitude and 140°E and 85°E longitude. The area includes the western edge of Micronesia, but a brief perusal of the checklist revealed no listing of specimens from Micronesia. A small collection of Enewetak ostracods in the suborder Myodocopina at the National Museum of Natural History, Smithsonian Institution, contains members of all five families that comprise the suborder. Although the species in the collection are capable of swimming, and do so occasionally, they spend most of their existence crawling on, or burrowing in, the substrate. An exception to this is members of the mainly pelagic genus Cypridina, which is represented in the collection by two species. Some of the Enewetak specimens are illustrated.

43892 (DOE/EV/00703—T1-Vol.2, pp 221-233) **Crustacea decapoda (Penaeidea, Stenopodidea, Caridea, and Palinura) of Enewetak Atoll.** Devaney, D.M.; Bruce, A.J. (Bernice P. Bishop Museum, Honolulu, HI (USA)). 1987. NTIS, PC A15/MF A01. Order Number DE87006111/JAW.

In The natural history of Enewetak Atoll: Volume 2, Biogeography and systematics.

Biological surveys made during 1946 and 1947 in the northern Marshall Islands included faunal collections that resulted in a publication by Chace (1955) on several groups of shrimps. In this work, six species of sergestid, pasiphaeid, processid, and alpheid shrimps were recorded from Enewetak. Since then the number of taxa from the atoll has increased until now nearly 150 decapod shrimp and lobster species are recognized. Pontoniines and alpheids account for 73% (106 species) of the total number. There are several new records not only for Enewetak but also for the Marshalls,

and in some cases, for the Pacific. A taxonomic checklist and a section on collection data for new records are provided.

43893 (DOE/EV/00703—T1-Vol.2, pp 235-261) **Crustacea Decapoda (Brachyura and Anomura) of Enewetak Atoll.** Garth, J.S.; Haig, J.; Knudsen, J.W. (Univ. of Southern California, Los Angeles (USA)). 1987. NTIS, PC A15/MF A01. Order Number DE87006111/JAW.

In The natural history of Enewetak Atoll: Volume 2, Biogeography and systematics.

The goals of this report are to list the numerous species of crabs found at Eniwetok. An attempt is made to indicate their biogeographic implications and to summarize their ecology. The Anomura presently known from Eniwetok Atoll comprise 76 species, representing 29 genera and 10 families. Of this number, 48 species are new to Eniwetok, and 43 are new to the Marshall Islands as well. The Brachyura presently known from Eniwetok Atoll comprise 291 species, representing 115 genera and 16 families. Of this number, 218 species are new to Eniwetok, and 170 are new to the Marshall Islands as well.

43894 (DOE/EV/00703—T1-Vol.2, pp 263-275) **Holothurians of Enewetak Atoll.** Cutress, B.M.; Rowe, F.W.E. (Univ. of Puerto Rico, Mayagueez). 1987. NTIS, PC A15/MF A01. Order Number DE87006111/JAW.

In The natural history of Enewetak Atoll: Volume 2, Biogeography and systematics.

An attempt is made to list the holothurians recorded on Eniwetok. A number of identified species are discussed in relation to their biogeography and ecology. Most of the species of holothurians recorded in the checklist were included in an unpublished systematic report by B. M. Cutress prepared for the Mid-Pacific Research Laboratory in 1956. Collection records based on that study are presented in the Appendix.

43895 (DOE/EV/00703—T1-Vol.2, pp 277-285) **Echinodermata other than Holothuroidea of Enewetak Atoll.** Devaney, D.M. (Bernice P. Bishop Museum, Honolulu, HI (USA)). 1987. NTIS, PC A15/MF A01. Order Number DE87006111/JAW.

In The natural history of Enewetak Atoll: Volume 2, Biogeography and systematics.

An attempt is made to bring together numerous records on the echinoderm fauna other than the holothurians at Eniwetok. In comparison with the Marshall Islands as a whole, knowledge of the Eniwetok echinoderms is considerable. A checklist is included of the echinoderm nonholothurian species of Eniwetok.

43896 (DOE/EV/00703—T1-Vol.2, pp 287-288) **Protochordates of Enewetak Atoll.** Eldredge, L.G. (Univ. of Guam, Mangilao). 1987. NTIS, PC A15/MF A01. Order Number DE87006111/JAW.

In The natural history of Enewetak Atoll: Volume 2, Biogeography and systematics.

Few protochordates have been recorded from Eniwetok Atoll. A checklist of Ascidians and Cephalochordates from Eniwetok is included.

43897 (DOE/EV/00703—T1-Vol.2, pp 289-324) **Annotated checklist of the fishes of Enewetak Atoll and other Marshall Islands.** Randall, J.E.; Randall, H.A. (Bernice P. Bishop Museum, Honolulu, HI (USA)). 1987. NTIS, PC A15/MF A01. Order Number DE87006111/JAW.

In The natural history of Enewetak Atoll: Volume 2, Biogeography and systematics.

This report provides a checklist of the reef, shore, and epipelagic fishes known from the Marshall Islands. A total of 817 species in 338 genera and 92 families is recorded. Deep-water fishes have been omitted from the checklist because only a few such fishes have been reported from the area. An attempt is made to illustrate a few of the most conspicuous species.

43898 (DOE/EV/00703—T1-Vol.2, pp 325-329) **Reptiles of Enewetak Atoll.** Lamberson, J.O. (Environmental Protection Agency, Newport, OR (USA)). 1987. NTIS, PC A15/MF A01. Order Number DE87006111/JAW.

In The natural history of Enewetak Atoll: Volume 2, Biogeography and systematics.

The goals of this report are to provide a checklist of all the reptiles found on Eniwetok. Seven species of lizards and one species of blind snake comprise the known terrestrial herpetofauna there. Species found on nearby atolls may also be present on Eniwetok; however, no additional species have been collected from there. No amphibians or sea snakes have been found on Eniwetok. The biogeography and the ecology of the reptiles found there are presented.

43899 (DOE/EV/00703—T1-Vol.2, pp 331-332) **Birds of Enewetak Atoll.** Berger, A.J. (Univ. of Hawaii, Honolulu (USA)). 1987. NTIS, PC A15/MF A01. Order Number DE87006111/JAW.

In The natural history of Enewetak Atoll: Volume 2, Biogeography and systematics.

Most of the seabirds that occur at Eniwetok have a very wide range in the Pacific basin, and they have not been shown to demonstrate a tendency for subspeciation. Because of its geographical location, Eniwetok provides a nesting habitat for some species whose primary breeding range is north of the atoll and for others whose primary breeding range is south of it. Approximately 17 species of shorebirds that nest in Alaska or Siberia have been recorded as migrating to the Eniwetok Atoll in winter. A checklist of Eniwetok birds is presented.

43900 (DOE/EV/00703—T1-Vol.2, pp 333-335) **Mammals of Enewetak Atoll.** Reese, E.S. (Univ. of Hawaii, Honolulu (USA)). 1987. NTIS, PC A15/MF A01. Order Number DE87006111/JAW.

In The natural history of Enewetak Atoll: Volume 2, Biogeography and systematics.

Although man is the dominant mammal of Eniwetok, marine mammals are occasional visitors there. Twenty-seven species of whales, dolphins, and porpoises may be expected to occur at Eniwetok Atoll. A checklist is provided of the mammals of Eniwetok.

43901 (DOE/EV/00703—T1-Vol.2, pp 337-343) **Miscellaneous species records of Enewetak Atoll.** Titgen, R.H.; Burch, B.L. (Bernice P. Bishop Museum, Honolulu, HI (USA)). 1987. NTIS, PC A15/MF A01. Order Number DE87006111/JAW.

In The natural history of Enewetak Atoll: Volume 2, Biogeography and systematics.

The aim of this report is to provide a checklist of miscellaneous plant and animal species recorded at Eniwetok. The list includes some fossil material and/or material from drill cores.

5106 Regulations

REFER ALSO TO CITATION(S) 42776, 43280

52 ENVIRONMENTAL SCIENCES, AQUATIC

REFER ALSO TO CITATION(S) 43923

5201 Basic Studies

REFER ALSO TO CITATION(S) 43566, 43578, 43582, 43583, 43910

43902 (DP-MS—88-121) **Seasonal and diel patterns of larval fish drift in a western South Carolina swamp.** Kissick, L.A.; Paller, M.H.; Heuer, J.H. (Environmental and Chemical Sciences, Inc., Aiken, SC (USA)). 1988. Contract AC09-76SR00001. 13p. (CONF-880775—1). NTIS, PC A03/MF A01; 1; GPO Dep. Order Number DE88012420/JAW.

From American Society of Ichthyologists and Herpetologists meeting; Ann Arbor, MI, USA (5 Jul 1988).

Fish larvae were collected weekly during 1986-1987 from the lower 3 km of Steel Creek (Barnwell County), a riverine swamp, to assess reproduction in this rarely studied habitat type. In

1987, larvae appeared in the following order and abundance (as a percentage of the total diural density): blackbanded darter Percina nigromaculatus (3%) and other darters Etheostoma spp. (32%); pirate perch Aphredoderus sayanus (NA); pygmy sunfish Elassoma spp. (7%); chubsuckers Erimyson spp. (13%); bluespotted sunfish Enneacanthus gloriosus (16%); bluegill Lepomis macrochirus (1%), redbreast sunfish L.-auritus (<1%), brook silverside Labidesthes sicculus (6%) and ironcolor shiner Notropis chalybaeus (8%); warmouth L. gulosus (8%); spotted sunfish L. punctatus (NA). Unidentified cyprinids (2%), centrarchids (2%) and miscellaneous species (3%) were collected throughout the study period. Monthly diel collections showed that drift densities of chubsuckers, cyprinids, Etheostoma spp., bluegill and pygmy sunfish increased 41 to 160X after sundown; pirate perch and spotted sunfish were collected only at night. Swamp densities peaked during 2000-0159 h (111.5 per 100m), whereas densities in the channel that drained the swamp into the Savannah River peaked during 0200-0759 h (38.7). The later peak in the channel was attributed to larvae that had drifted from the swamp and were essentially lost from the system. 4 figs., 1 tab.

43903 **Nutrient enrichment in the Benthic Nepheloid Layer of Lakes Erie, Huron, and Michigan, 1983-1984.** Leaht, B.M.; Rockwell, D.C. (Environmental Research Div., Argonne National Lab., Argonne, IL (US)). pp 39 of International association for Great Lakes research: 29th conference. Scarborough, Ontario; Univ. of Toronto (1986). (CONF-8605252—Absts.).

From 29. International Association for Great Lakes Research conference; Scarborough, Canada (26 May 1986).

Data collected during the 1983-1984 water quality surveys of lakes Erie, Huron and Michigan show that summertime concentrations of both particulates and nutrients in the lower ten meters (at least) of the water column are significantly enriched relative to the overlying waters. Most pronounced in Lake Michigan, this enrichment was also observed in Lake Huron and in the eastern basin of Lake Erie during both years. By integrating the water column mass of total phosphorus and dissolved reactive silica before, during, and after, stratification the authors estimate that as much as 30% of the whole lake burden of these nutrients may be suspended within the benthic nepheloid layer before turnover. High concentrations of dissolved nutrient species indicate that this layer is an important site for nutrient cycling.

5202 Chemicals Monitoring And Transport

REFER ALSO TO CITATION(S) 42698, 42722, 42891, 43685, 43691, 43693, 43837, 43842, 43857, 43858, 43903, 43918, 43974

43904 (CONF-871075—Vol.1-Pt.3, pp 89-110) **Membrane-based systems for speciation and removal of metals from waste water.** Cox, J.A.; Bhatnagar, A.; Al-Shakshir, S. (Miami Univ., Oxford, OH (USA)). 1987. NTIS, PC A18/MF A01. Order Number DE88007805/JAW.

From 3. Oak Ridge model conference on waste problems; Oak Ridge, TN, USA (13 Oct 1987).

The separation of a sample from a receiver by a membrane comprises a simple method for removal of selected species from the sample. To have a sufficient transport rate, the process must be driven against the concentration gradient of the test species. Two methods for accomplishing uphill transport of metal ions, Donnan dialysis across ion exchange membrane and proton-coupled transport across ligand-containing liquid membrane, will be described and compared. In addition, a method which uses only ion-pairing to cause uphill transport of arsenic across a nonpolar liquid membrane will be described. Data will be shown to demonstrate that Donnan dialysis and proton-coupled transport have similar transport rates under ideal conditions. The latter may be less useful when a set of metals is to be removed by immobilization of a general complexing agent in the liquid membrane. The former has a limited ability to separate a selected metal and also is not suitable for high ionic strengths samples. Among the systems to be described is the transport of Zn(II) from a mixture of metals by Donnan dialysis and by coupled transport across a dithizone-containing liquid membrane. In the latter case, the presence of other metals in the sample lowered the transport rate.

43905 (CONF-871075—Vol.1-Pt.3, pp 129-152) **Purification and recovery of waste acids by continuous ion exchange.** Denton, M.S.; Higgins, I.R. (CSA, Inc., Oak Ridge, TN (USA)). 1987. NTIS, PC A18/MF A01. Order Number DE88007805/JAW.

From 3. Oak Ridge model conference on waste problems; Oak Ridge, TN, USA (13 Oct 1987).

Two very different ion exchange methods are to be discussed for the purification and reuse of acid. One is based on recycle of phosphoric acid. The other is called Acid Retardation, and applies to the highly ionized acids. Phosphoric acid is commonly used for metal treatment. Phosphoric acid is used to clean other metals, steel, and stainless steel, to remove scale, or radioactivity. Activated carbon is made by leaching out the ash components of wood, Ca, Mg, K, and Na, using H_3PO_4. Phosphoric acid is not only expensive, but also enhances algae growth when dumped to the environment. Continuous Countercurrent Ion Exchange (CCIX) equipment, is paramount in maintaining H_3PO_4 strength and being able to tolerate the very low distribution coefficient of metal ions for cation resin. A successful production plant will be presented which has included mobile equipment and a Model 3624 Folded CCIX unit that extracts 95% to 99% of the metals from 35% H_3PO_4 at about 60 gpm. In strong ionized acids or salt plus acids there is selective and strong sorption of the H-ion. Water is, therefore, the only eluting agent necessary for the acid. This is called Acid Retardation and is useful for salt-acid separations. Specific areas of application are, anodizing wastes, cation regenerant wastes, lead battery waste, electrowinning cell blow-down waste, and more generally almost any industrial waste that is a mixture of acid and salts. Again, continuous countercurrent flow is vital for practicability, to keep solutions strong.

43906 (CONF-871075—Vol.1-Pt.3, pp 153-163) **Toxicity reduction and improvements in biodegradability of industrial wastewaters using hydrogen peroxide oxidation.** Bowers, A.R.; Eckenfelder, W.W. Jr.; Gaddipati, P.; Monsen, R.M. (Vanderbilt Univ., Nashville, TN (USA)). 1987. NTIS, PC A18/MF A01. Order Number DE88007805/JAW.

From 3. Oak Ridge model conference on waste problems; Oak Ridge, TN, USA (13 Oct 1987).

A procedure to evaluate the technical and economic feasibility of chemical oxidation for the pretreatment of toxic and hazardous organic compounds in industrial wastewaters has been developed. The proposed process involves the reaction of catalyzed hydrogen peroxide with refractory, toxic and/or inhibitory organics to produce intermediate oxidation products, i.e., organic carbon based compounds, rather than CO_2, that are much more biocompatible than the original compounds. By coupling the oxidative pretreatment of toxic compounds with conventional biological treatment processes, and eliminating the need for complete chemical oxidation to CO_2, chemical oxidation becomes more economically attractive. Pure compounds, such as 2,4-dichlorophenol, and actual industrial wastewaters were evaluated. In general, the toxicity rating of the organic compounds was improved by at least an order of magnitude for those wastes which were reactive with hydrogen peroxide. The biodegradability, before and after reaction with hydrogen peroxide, was evaluated using Fed-Batch reactors and both unamended municipal sludge and standard laboratory biomass. In several cases, the reacted wastes exhibited an increase in the biodegradability, even though the sludge was not specifically acclimated to the oxidation products.

43907 (CONF-871075—Vol.1-Pt.3, pp 185-214) **Photocatalytic oxidation of toxic organic substances.** Davis, A.P.; Tseng, J.M.; Huang, C.P. (Univ. of Delaware, Newark (USA)). 1987. NTIS, PC A18/MF A01. Order Number DE88007805/JAW.

From 3. Oak Ridge model conference on waste problems; Oak Ridge, TN, USA (13 Oct 1987).

An innovative physico-chemical method, photocatalytic oxidation, for the treatment of toxic organic compounds in waters and waste water was studied. Absorption of light radiation corresponding to the bandgap energy of a semi-conductor results in the formation of electrons and holes in the solids. Electrostatic forces attract the positive holes, which are powerful oxidizing agents, to the surface where adsorbed organic contaminants can be oxidized to

harmless products and other environmentally acceptable inorganic forms. Powdered TiO_2 and WO_3 are semi-conductors examined under UV light excitations. Visible light is used for oxidation using CdS and Fe_2O_3. Organic compounds such as phenol, chlorophenol, dichlorophenol, and trichlorophenolethylene all can be oxidized under photocatalytic conditions. The formation of CO_2 is verified by the precipitation of $BaCO_3$ from a purge gas stream. Phenol oxidation using CdS is first order with respect to light intensity and close to zero-order with respect to catalyst concentration as is expected for photocatalytic reactions. Efficient oxidation requires a high dissolved oxygen concentration. Solution pH plays an important role and the presence of dissolved metals inhibit the reaction. A mechanism and kinetic model was exemplified by phenol oxidation.

43908 **(CONF-871075—Vol.1-Pt.3, pp 459-484) Use of on-site chemical analyses in the identification of ground water contamination sources affecting the Rockaway Borough well field.** Manikas, C.S.; Boyer, K.R. (Science Applications International Corp . McLean, VA (USA)). 1987. NTIS, PC A18/MF A01. Order Number DE88007805/JAW.

From 3. Oak Ridge model conference on waste problems; Oak Ridge, TN, USA (13 Oct 1987).

The contamination of ground water aquifers by chlorinated solvents in the Rockaway River Valley of northern New Jersey has become a major public health concern in municipalities that rely on the glacial aquifer in this area as a sole-source water supply. Selecting time- and cost-effective approaches to locating sources of ground water contamination in urban and industrialized areas such as the Rockaway River Valley presents a challenge for conventional site investigation strategies. Field chemical analyses were applied to an investigation of the Rockaway Borough well field and the designated sole-source glacial aquifer supplying the well field. The aquifer and the Borough water supply were found to be contaminated with up to 680 parts per billion (ppb) of tetrachloroethylene (PCE) and 172 ppb of trichloroethylene (TCE) in 1980. The sources of the contaminants had not been identified in 1982 when the well field was placed on the USEPA National Priorities List (NPL) of uncontrolled hazardous waste sites. A limited site investigation was conducted using on-site chemical analyses of ground water samples and soil sample headspace gases. The investigation identified optimal monitoring well locations, provided cost-effective time series sampling data, and identified the locations of three potential contaminant sources.

43909 **(DOE/NV/10327—32) In situ monitoring of organics site description and plan of investigation for the Desert Rock fuel release.** McGrath, D.A. (Reynolds Electrical and Engineering Co., Inc., Las Vegas, NV (USA)). Mar 1988. Contract AC05-84OR21400;AC08-84NV10327. 41p. NTIS, PC A03;3. Order Number DE88008459/JAW.

The Nevada Test Site is used by the United States Department of Energy (U.S. DOE), primarily for the testing of nuclear weapons. A portion of the site has been designated as a repository for low-level radioactive waste. In anticipation of permitting this location as a mixed waste disposal site, certain studies have been undertaken by REECo under the auspices of the U.S. DOE, Hazardous Waste Remedial Actions Program. In 1985 a large accidental spill of jet aviation fuel occurred at the Desert Rock airstrip on the Nevada Test Site. Study of the distribution of certain components of the fuel will aid in the development of soil air samplers for the vadose zone. These will be useful for the investigation of the migration of hazardous substances from a mixed waste disposal site or other underground storage facility. A general description of the topography, geology, hydrology, and meteorology of the NTS is given. Also, the plan of investigation for development of the sampler is presented. 34 refs., 13 figs., 6 tabs.

43910 **(GKSS—87/E/53) Reduction of sulfate in sediments of the Elbe estuary.** Tiedemann, H.; Wilken, R.D. (GKSS-Forschungszentrum Geesthacht G.m.b.H., Geesthacht-Tesperhude (Germany, F.R.). Inst. fuer Chemie). (GKSS-Forschungszentrum Geesthacht G.m.b.H., Geesthacht-Tesperhude (Germany, F.R.)). 1987. 35p. (In German). NTIS (US Sales Only), PC A03/MF A01. Order Number DE88753776/JAW.

From autumn 1984 to summer 1985 sulfate reduction rates were measured at three sampling locations in the tidal influenced Elbe river (Oortkaten, Muehlenberger Loch, Neufelder Watt), using the /sup 35/S-technique. The average water discharge was ≈ 750m/sup 3//s. The sulfate reduction rates were measured at different depths (every 2 cm). The reduction was normal at first, depending on temperature of the sample, in the first two cm; though often two zones of higher rates were found down to a depth of 35 cm. Reduction occurred not only in the temperature range of 15-20/sup 0/C, but also down to temperatures of 4/sup 0/C (more than 100 nmol SO/sub 4//sup 2-//cm/sup 3//day). (orig.) With 9 figs., 5 tabs.

43911 **(UCID—21369) Closure plan for the decommissioned high explosives rinse-water lagoons at Lawrence Livermore National Laboratory Site 300.** Carpenter, D.W.; Lamarre, A.L.; Crow, N.B.; Swearengen, P.M. (Lawrence Livermore National Lab., CA (USA)). 31 May 1988. Contract W-7405-ENG-48. 180p. NTIS, PC A09. Order Number DE88013161/JAW.

The High Explosives (HE) Process Area is a major facility at Lawrence Livermore National Laboratory (LLNL) Site 300. Within the Process Area, rinse water from various buildings formerly was discharged to nine relatively small, unlined lagoons where it was disposed of by evaporation and infiltration. In 1985, LLNL decommissioned these lagoons and diverted the rinse waters to two doubly lined surface impoundments. LLNL conducted the hydrogeologic investigations required to support the permanent closure of the none decommissioned lagoons. These studies included drilling ground water monitoring wells and extensively collecting soil and rock samples, which were analyzed for EPA toxic metals, HE compounds, and purgeable and extractable priority organic pollutants. On October 26, 1987, the RWQCB requested that we prepare a comprehensive report to summarize and discuss the findings of the LLNL HE Process Area Investigation. This report is our response to the Board's request. 22 refs., 19 figs. , 45 tabs.

43912 **Aqueous ozonolysis products of methyl- and dimethylnaphthalenes.** Gaul, M.D.; Junk, G.A.; Svec, H.J. (Ames Lab., IA (USA)). *Environmental Science and Technology;* **21**: No. 8, 777-784(Aug 1987).

The ozonolyses of 1- and 2-methylnaphthalene and 1,2-, 1,3-, 1,4-, and 2,3-dimethylnaphthalene were performed in dilute aqueous solution, and the resulting nonperoxidic products were extracted, concentrated, and identified. Identification of the ozonolysis products was confirmed by comparison of retention indexes and mass and infrared spectroscopy data with those from authentic samples when possible. The compound identifications were facilitated by comparisons with products from parallel ozonolysis reactions performed in n-hexane and methanol at higher concentrations. The aqueous ozonolysis of 1-methyl-naphthalene yielded four major products: 2-acetylbenz-aldehyde due to the cleavage of two double bonds and (E)- and (Z)-3-(2-acetylphenyl)-2-butenal and (Z)-3-(2-acetyl-phenyl)propenal due to the cleavage of a single double bond. The products resulting from the ozonolysis of 2-methylnaphthalene and the isomeric dimethyl-naphthalenes were analogous to those formed for 1-methylnaphthalene. 40 references, 4 figures, 6 tables.

43913 **The dynamic behavior of PCB's in Lake Superior.** Looney, B.B.; Eisenreich, S.J. (Savannah River Lab., DuPont, Aiken, SC (US)). pp 40 of International association for Great Lakes research: 29th conference. Scarborough, Ontario; Univ. of Toronto (1986). (CONF-8605252—Absts.).

From 29. International Association for Great Lakes Research conference; Scarborough, Canada (26 May 1986).

Data from Lake Superior and quantitative mass balance modeling indicate that sediment resuspension combined with winter ice cover and snow melt result in elevated water column PCB concentrations during the spring. Concentrations decrease during the summer due to sedimentation and volatilization. Scavenging of PCB-laden particles by precipitation is the major input process. A function which characterizes the atmospheric concentration of PCB's in remote environments based on the concept of a mixed "mobile environmental reservoir" was developed as an input to the model. Based on the reference model parameters, the average water

column PCB concentration should decrease from 0.9 ng/L in 1980 to 0.2 ng/L in 1990. Field data corroborate model predictions.

5203 Radioactive Materials Monitoring And Transport

REFER ALSO TO CITATION(S) 42725, 42751, 42768, 42865, 43204, 43847, 43848, 43857, 43864, 43869

43914 **(AERE-M—3569) Note on the equations used to model flow and transport in the undersaturated zone.** Jackson, C.P. (UKAEA Harwell Lab. Theoretical Physics Div.; Department of the Environment, London (UK)). Feb 1988. 19p. (DOE-RW—87.067). H.M. Stationery Office, London, price Pound 4.00.

We consider the form of the equations used to model groundwater flow and transport in partially saturated media. We briefly review porous media modelling and flow in partially saturated media; we discuss a simple model of transport that includes the effects of advection, dispersion, radioactive decay and sorption; and suggest an enhancement of this model to include the effect of immobile water. We analyse a very simple model porous medium to derive a likely form for the dependence upon saturation of the parameters of the models.

43915 **(INIS-BR—1027) Determination of isotopic and total thorium at ultra-trace level in water by α - spectroscopy and micro-injection ICP-AES.** Miekeley, N.; Vale, M.G.R.; Silveira, C.L.P. da. (Pontificia Univ. Catolica do Rio de Janeiro (Brazil). Dept. de Quimica). 1987. 11p. NTIS (US Sales Only), PC A03/MF A01. Order Number DE88702602/JAW.

A sequential method for the determination of isotopic and total thorium has been developed. The method is based on the combination of thorium preconcentration, high resolution α - spectroscopy processes and, the use of ICP-AES system. This method permits the determination of isotopic thorium in samples, such as, ground waters, with concentrations of Th-232 $>$ 0.016 ppb and with high activity ratios of Th-228: Th-232, in wich the utilization of α - spectroscopy alone, would completely fail.

43916 (INIS-mf—11210, pp III35-III36) **Stochastic parameter evaluation in modelling underground transport of radioactivity.** Reznik, L.; Tepper, L. (Israel Electric Corp. Ltd., Haifa (Israel). Dept. of Nuclear Engineering). Dec 1987. NTIS (US Sales Only), PC A13/MF A01. Order Number DE88780087/JAW. (CONF-871287—).

From Nuclear Societies of Israel annual meeting; Haifa, Israel (21 Dec 1987).
Transactions.; V. 14.

43917 (KURRI-TR—290, pp 52-57) **Metabolic transformation of radionuclides in marine organisms.** Koyanagi, Taku. (National Inst. of Radiological Sciences, Nakaminato, Ibaraki (Japan). Nakaminato Lab. Branch Office). Jun 1987. (In Japanese). NTIS (US Sales Only), PC A05/MF A01. Order Number DE88780086/JAW. (CONF-8607368—).

From Short-term conference on biological transformation of radionuclides in the environment and dose assessment; Kumatori, Japan (23 Jul 1986).

Physico-chemical form of radionuclides is one of the important factors governing the concentration by marine organisms, whereas biological activities affect the existing states of radionuclides especially in coastal waters. Radioiodine in the form of iodate which is predominant species in seawater is reduced to iodide ion by biological activities and concentration factor of iodide is an order of magnitude higher than those of iodate. Extremely high accumulation of transition elements, actinides, or natural radionuclides in branchial heart of octopus is explained by the fuction of adenochrome, a glandular pigment in the organ as a natural complexing agent, and similar metal-binding proteins with relatively low molecular weight have been found in various marine invertebrates. High accumulation of some elements also found in mollusk kidney is considered to be caused by the intracellular concretions composed of calcium phosphate. All these biological processes suggest the significance of further investigations on metabolic transformation of radionuclides in marine organisms.

5205 Site Resource And Use Studies

REFER ALSO TO CITATION(S) 42890, 42893, 43282, 43283, 43871, 43872, 43873, 43874, 43875, 43876, 43877, 43878, 43879, 43880, 43881, 43882, 43883, 43884, 43885, 43886, 43887, 43888, 43889, 43890, 43891, 43892, 43893, 43894, 43895, 43896, 43897, 43898, 43899, 43900, 43901

43918 **(DOE/MC/11076—2457) The Hanna and Hoe Creek underground coal gasification test sites: Status report, [June 1986-June 1987].** Berdan, G.L.; Nolan, B.T.; Barteaux, W.L.; Barrash, W. (Western Research Inst., Laramie, WY (USA)). Jun 1987. Contract FC21-86MC11076. 27p. NTIS, PC A03/MF A01; 1; GPO Dep. Order Number DE88009100/JAW.

To comply with a cooperative agreement with the U.S. Department of Energy (DOE), the Western Research Institute (WRI) is required to submit an annual report summarizing the status of environmentally related work performed by WRI at the Hanna and Hoe Creek underground coal gasification (UCG) sites. The following is a summary of work performed at these two sites from June 1986 to June 1987. Several tasks for restoring the water quailty at Hoe Creek were: (1) groundwater treatment demonstration (1986); (2) bench-scale carbon adsorption experiments (1987); (3) design of the scaled-up treatment system (1987); (4) well-pumping test (1987). A summary of the results of each task is presented. 6 refs., 8 figs., 4 tabs.

5206 Regulations

REFER ALSO TO CITATION(S) 43280, 43847

53 ENVIRONMENTAL-SOCIAL ASPECTS OF ENERGY TECHNOLOGIES

5301 Social And Economic Studies

REFER ALSO TO CITATION(S) 43274

5302 Assessment Of Energy Technologies

REFER ALSO TO CITATION(S) 42899, 43280, 43388, 43389

43919 **(DOE/EIS—0125-F-Vol.1) Intertie development and use: Final environmental impact statement: Volume 1, Environmental analyses.** (USDOE Bonneville Power Administration, Portland, OR). Apr 1988. 440p.

The Bonneville Power Administration (BPA) has identified the need to enable short- and long-term contractual sales of Federal power surplus to Northwest loads and to manage other interregional transfers of power over the Pacific Northwest/Pacific Southwest Intertie. There are three proposed options: to increase the capacity of the Intertie; to adopt a Long Term Intertie Access Policy (IAP), which will set the ground rules for use of the Intertie by utilities other than BPA for short- and long-term transmission of surplus power to California; and options whereby BPA would promote, through its access policies and marketing efforts, various types and levels of firm power marketing between the Northwest and California. The LTIAP also addresses access to the Intertie for new resources, access as it relates to the Administrator's efforts to enhance fish and wildlife and access to the Intertie by extraregional utilities. 92 refs., 22 figs., 94 tabs.

43920 **(DOE/EIS—0125-F-Vol.3) Intertie development and use: Final environmental impact statement: Volume 3, Comment letters: Part 1, IDU draft EIS, Part 2, Hydro operations information paper, Part 3, Revised Intertie access policy.** (USDOE Bonneville Power Administration, Portland, OR). Apr 1988. 1121p. NTIS, PC A99;3. Order Number DE88008508/JAW.

The Bonneville Power Administration (BPA) has identified the need to enable short- and long-term contractual sales of federal power surplus to Northwest loads and to manage other interre-

gional transfers of power over the Pacific Northwest/Pacific Southwest Intertie. There are three proposed options: to increase the capacity of the Intertie; to adopt a Long Term Intertie Access Policy (IAP), which will set the ground rules for use of the Intertie by utilities other than BPA for short- and long-term transmission of surplus power to California; and options whereby BPA would promote, through its access policies and marketing efforts, various types and levels of firm power marketing between the Northwest and California. The LTIAP also addresses access to the Intertie for new resources, access as it relates to the Administrator's efforts to enhance fish and wildlife and access to the Intertie by extraregional utilities.

43921 **(DOE/EIS—0125-F-Vol.4) Intertie development and use: Final environmental impact statement: Volume 4, Appendices.** (USDOE Bonneville Power Administration, Portland, OR). Apr 1988. 565p. NTIS, PC A24;3. Order Number DE88008507/JAW.

The Bonneville Power Administration (BPA) has identified the need to enable short- and long-term contractual sales of federal power surplus to Northwest loads and to manage other interregional transfers of power over the Pacific Northwest/Pacific Southwest Interties. There are three proposed options: to increase the capacity of the Intertie; to adopt a Long Term Intertie Access Policy (IAP), which will set the ground rules for use of the Intertie by utilities other than BPA for short- and long-term transmission of surplus power to California; and options whereby BPA would promote, through its access policies and marketing efforts, various types and levels of firm power marketing between the Northwest and California. The LTIAP also addresses access to the Intertie for new resources, access as it relates to the Administrator's efforts to enhance fish and wildlife and access to the Intertie by extraregional utilities.

43922 **(NUREG—0683-Suppl.3-Draft) Programmatic environmental impact statement related to decontamination and disposal of radioactive wastes resulting from March 28, 1979 accident, Three Mile Island Nuclear Station, Unit 2 (Docket No. 50-320): Draft supplement dealing with post-defueling monitored storage and subsequent cleanup.** (Nuclear Regulatory Commission, Washington, DC (USA). Office of Nuclear Reactor Regulation). Apr 1988. 201p. NTIS, PC A09/MF A01 - GPO;1. Order Number TI88008528/JAW.

In accordance with the National Environmental Policy Act, the Commission's implementing regulations, and its April 27, 1981,Statement of Policy, the Programmatic environmental impact statement related to decontamination and disposal of radioactive wastes resulting from March 28, 1979 accident Three Mile Island Nuclear Station, Unit 2, NUREG-0683 (PEIS) is being supplemented. This draft supplement updates the enviromental evaluation of cleanup alternatives published in the PEIS, utilizing more complete and current information. Also, the draft supplement includes a specific environmental evaluation of the licensee's recently submitted proposal for post-defueling monitored storage. The NRC staff has concluded that the licensee's proposal to place the facility in a monitored storage configuration will not significantly affect the quality of the human environment. Further, any impacts from the long-term storage of the facility are outweighed by its benefits. 63 refs., 23 figs., 65 tabs.

55 BIOMEDICAL SCIENCES, BASIC STUDIES

43923 **(ORNL—6473) Biomedical and Environmental Sciences Program publications, 1987.** Johnson, C.A.; Deaton, D.H.; Ellis, J.R.; Norman, V.S.; Rader, K.J. (Oak Ridge National Lab., TN (USA)). Jun 1988. Contract AC05-84OR21400. 78p. NTIS, PC A05. Order Number DE88013338/JAW.

This bibliography contains more than 600 references to journal articles, book chapters and proceedings, reports, abstracts, and newsletters published during 1987 under Oak Ridge National Laboratory Biomedical and Environmental Sciences programs. Publications authored by members of the Biology Division, Environmental Sciences Division, and Health and Safety Research Division are listed, in addition to those authored by members of divisions that receive funding through the Associate Laboratory Director for Biomedical and Environmental Sciences. A number of 1986 references that were not entered into the Laboratory Records database in time for the previous publication are also included in this document. The bibliography is organized by publication type (i.e., journal articles, books, etc.), then by division, and, within each division, alphabetically by the senior author. Indexes for authors and journal articles are also provided. More than 290 journal articles were published in 1987—a healthy 22% increase over the number published in 1986. Most of these articles appeared in refereed journals, which is an excellent indication of the importance of the subject matter and of the thoroughness in its presentation. Publications not appearing in this document include theses, dissertations, book reviews, documents or reports prepared for internal distribution, letters to editors, and abstracts published in nonreferenced sources.

5501 Behavioral Biology

43924 **Herbivorous and parasitic insect guilds associated with Great Basin wild rye (Elymus cinereus) in southern Idaho.** Youtie, B.A.; Stafford, M.; Johnson, J.B. (Univ. of Idaho, Moscow (USA)). *Great Basin Naturalist;* 47: No. 4, 644-651(31 Oct 1987).

Insects inhabiting Great Basin wild rye (elymus cinereus Scribn. & Merr.) were surveyed at two sites on the Snake River Plain in southern Idaho during 1982 and 1983. Forty-six species of phytophagous insects were observed. In addition, eight parasitoid species were reared from insect hosts in the plant culms and identified. Life stage, abundance, plant part utilized, and study site were recorded for each insect species collected. Insect guilds at the two sites were compared based on species presence utilizing Sorensen's similarity index. Overall, 26 insect species were common to both sites, yielding a moderate similarity index of 0.62. The majority of the species that constitute the wild rye herbivore guilds were oligophagous (restricted to grasses). Many of these insects feed on grain crops as well as other native and introduced grasses. The relatively high diversity of phytophages on wild rye may be due to its tall, bunchgrass growth form, its abundance within its habitat, its broad geographic range, and the large number of related species of grasses in the region.

5502 Biochemistry

REFER ALSO TO CITATION(S) 43480, 43973

43925 **(CONF-880361—2) Batchwise synthesis of dihydroneopterin triphosphate with recycling of guanosine triphosphate cyclohydrolase I.** Ferre, J.; Naylor, E.W.; Jacobson, K.B. (Martin Marietta Energy Systems, Inc., Oak Ridge, TN (USA)). 1988. Contract AC05-84OR21400. 9p. NTIS, PC A 02; 3; GPO Dep. Order Number DE88012202/JAW.

From Annual international pteridine workshop; Snowbird, UT, USA (13 Mar 1988).

Synthesis of NH_2P_3 in the ultrafiltration cell allows continuous utilization of GCH I, thus yielding a much higher production of NH_2P_3 than with other traditional methods. The procedure takes advantage of the high stability of the E. coli enzyme, since typically the same enzyme batch is used for two or more weeks at 42°C. The purity of the so synthesized NH_2P_3 is satisfactory for utilization with enzymes of the pteridine pathway. However, if separation of NH_2P_3 from buffer components is desired, it can be accomplished using silica-bonded cartridges with a separation protocol that takes advantage of the highly negative charge density of the NH_2P_3 molecule.

43926 **Laser-based optical activity detection of amino acids and proteins.** Reitsma, B.H. Ames, IA; Iowa State Univ. (1987). 110p. University Microfilms Order No. 87-21,923.

Thesis (Ph. D.).

The optical activity detector (OAD) for HPLC is a selective detector for optically active substances including amino acids and proteins. This study illustrates the use of the OAD in three related

areas. Section I illustrates the separation of four free amino acids using cation-exchange chromatography. Detection by coupling the OAD to a refractive index detector (RI) for proline and threonine and the OAD to an ultraviolet absorbance detector (UV) for tyrosine and phenylalanine allows the calculation of enantiomeric (D/L) ratios of these amino acids without physical separation. Specific rotations of these four amino acids are also reported. Section II illustrates the separation of 16 dansyl-L-amino acids by RP-HPLC with detection by OA/UV. Section III illustrates the RP-HPLC separation of conformers of soybean trypsin inhibitor. Detection by OA/UV provides insights from the chromatogram unavailable for UV absorbance detection alone. In addition, identification of impurities is simplified with OA/UV. Specific rotations of the separated protein fractions show no significant change accompanying change in conformation.

5505 Metabolism

43927 **Synthesis of suicide inhibitors of monoamine oxidase: carbon-11 labeled clorgyline, L-deprenyl and D-deprenyl.** MacGregor, R.R.; Fowler, J.S.; Wolf, A.P.; Halldin, C.; Langstroem, B. (Brookhaven National Lab., Upton, NY (USA); Uppsala Univ. (Sweden). Inst. of Chemistry). *Journal of Labelled Compounds and Radiopharmaceuticals;* **25**: No. 1, 1-9(Jan 1988).

The suicide inhibitors of monoamine oxidase type A and B, clorgyline and L-deprenyl have been labeled with carbon-11 by [^{11}C]methylation of the norbases with [^{11}C]H_3I. The less active enantiomer of deprenyl (D-deprenyl) was also labeled using this procedure. The synthesis time was 35 minutes, the radiochemical yield was 25-40% and the specific activity was 0.8-2.0 Ciμmol (calculated to EOB). Procedures for synthesis of the precursor norbases as well as the synthesis of unlabeled clorgyline, L-deprenyl and D-deprenyl are given.

5506 Medicine

REFER ALSO TO CITATION(S) 42847, 43610, 43682

43928 **(BNL—41348) Dose inhomogeneities at various levels of biological organization.** Bond, V.P. (Brookhaven National Lab., Upton, NY (USA)). 1988. Contract AC02-76CH00016. 13p. (CONF-8805150—1). NTIS, PC A03/MF A01; 1; GPO Dep. Order Number DE88012144/JAW.

From 4. international conference on neutron capture therapy; Bremen, F.R. Germany (31 May 1988).

Dose inhomogeneities in both tumor and normal tissue, inherent to the application of boron neutron capture therapy (BNCT), can be the result not only of ununiform distribution of ^{10}B at various levels of biological organization, but also of the distribution of the thermal neutrons and of the energy depositions from more energetic neutrons and other radiations comprising the externally-applied beams. The severity of the problems resulting from such inhomogeneities, and approaches to evaluating them, are illustrated by three examples, at the macro, micro and intermediate levels.

43929 **(CEA-CONF—9349) Positron emission tomography studies in the normal and abnormal ageing of human brain.** Comar, D.; Baron, J.C. (CEA Centre d'Etudes Nucleaires de Saclay, 91 - Gif-sur-Yvette (France). Dept. de Biologie). 1987. 13p. (CONF-8711203—). NTIS (US Sales Only), PC A03/MF A01. Order Number DE88754046/JAW.

From WHQ international workshop on epidemiology of mental and neutrological disorders in the elderly; Beijing, China (16 Nov 1987).

Until recently, the investigation of the neurophysiological correlates of normal and abnormal ageing of the human brain was limited by methodological constraints, as the technics available provided only a few parameters (e.g. electroencephalograms, cerebral blood flow) monitored in superficial brain structures in a grossly regional and poorly quantitative way. Lately several non invasive techniques have been developed which allow to investigate in vivo both quantitatively and on local basis a number of previously inaccessible important aspects of brain function. Among these techniques, such as single photon emission tomography imaging of computerized electric events, nuclear magnetic resonance, positron emission tomography stands out as the most powerful and promising method since it allows the in vivo measurement of biochemical and pharmacological parameters.

43930 **(CONF-8609383—, pp 6-14) SPECT imaging: how it fits clinically.** Henkin, R.E. Sep 1986. NTIS, PC A07/MF A01. Order Number DE88003984/JAW.

From Joint international symposium on SPECT in clinical practice; Washington, DC, USA (22 Sep 1986).

In summary, there are a number of studies that are available to the clinician at the present time, that he can justify employing SPECT as an adjunct to. It encompasses almost every area of Clinical Nuclear Medicine. Certainly, the areas that show the best promise at the moment for both quantitative and diagnostic improvement, remain the cardiac areas, bone scanning and liver. The central nervous system is in evolution and over the slightly longer term, should show tremendous clinical yield using SPECT techniques with some of the newer pharmaceuticals. However, even six or more years after the clinical introduction of SPECT technology, new applications are being reported relatively frequently. It is anticipated that there is no organ system that will not be amendable to SPECT study and the potential quantification that such a technique possess.

43931 **(CONF-8609383—, pp 16-21) Review of current instrumentation.** Anger, R.T. Sep 1986. NTIS, PC A07/MF A01. Order Number DE88003984/JAW.

From Joint international symposium on SPECT in clinical practice; Washington, DC, USA (22 Sep 1986).

An overview is presented of the developments that have occurred since 1979 in rotating gamma camera-based single photon emission computed tomography.

43932 **(CONF-8609383—, pp 23-25) Understanding algorithms.** Oppenheim, B.E. Sep 1986. NTIS, PC A07/MF A01. Order Number DE88003984/JAW.

From Joint international symposium on SPECT in clinical practice; Washington, DC, USA (22 Sep 1986).

The reconstruction problem is to reconstruct a two-dimensional object from a set of one-dimensional projections of that object. Nowadays the problem is almost always solved by using the method of filtered backprojection, in which the projections are modified in some mysterious manner and then backprojected across the image plane, yielding a reasonable likeness of the object. The purpose of this paper is to provide an intuitive basis for understanding how and why this method works, based on the concept of the Fourier transform.

43933 **(CONF-8609383—, pp 27-32) Looking at things a different way: filtering and backprojection.** Garcia, E.V.; Galt, J.R.; Hise, H.L. Sep 1986. NTIS, PC A07/MF A01. Order Number DE88003984/JAW.

From Joint international symposium on SPECT in clinical practice; Washington, DC, USA (22 Sep 1986).

Filtering is used extensively on Nuclear Medicine images to reduce statistical noise, enhance edges for edge detection, and in the reconstruction of tomographic images. Filtering can be performed in either the spatial domain or in frequency space. While many articles deal with operations in the spatial domain, the purpose of this presentation is to help develop intuition as to how to use frequency space without understanding complicated mathematical formulas. By exercising this intuition, one should be able to select filters for given applications, determine proper cutoff frequencies, and even design filters to meet the requirements of new applications.

43934 **(CONF-8609383—, pp 34-40) Effects of attenuation in SPECT.** Moore, S.C. Sep 1986. NTIS, PC A07/MF A01. Order Number DE88003984/JAW.

From Joint international symposium on SPECT in clinical practice; Washington, DC, USA (22 Sep 1986).

The general goal of any SPECT imaging procedure is to obtain cross-sectional image(s) of the intensity distribution of a

given radionuclide in a given organ. These images are usually reconstructed from a complete set of projection images, each acquired at a different angle, by using a standard reconstruction algorithm, such as filtered backprojection. It is straightforward to show that an exact analytic reconstruction can be obtained (in the limit of infinitely fine sampling and an infinite number of counts) only if the number of counts measured for each projection ray is directly proportional to the line integral of the activity distribution along the ray. Unfortunately, there are several physical effects which violate this requirement for an exact, analytic reconstruction. The effects to be considered in this presentation are (1) attenuation of emitted photons, and (2) scattered photons which are detected.

43935 (CONF-8609383—, pp 42) **Uniformity requirements in SPECT.** Muehllehner, G. Sep 1986. NTIS, PC A07/MF A01. Order Number DE88003984/JAW.

From Joint international symposium on SPECT in clinical practice; Washington, DC, USA (22 Sep 1986).

43936 (CONF-8609383—, pp 44) **Clinicians guide to technical artifacts.** Keyes, J.W. Sep 1986. NTIS, PC A07/MF A01. Order Number DE88003984/JAW.

From Joint international symposium on SPECT in clinical practice; Washington, DC, USA (22 Sep 1986).

Most SPECT artifacts arise as a consequence of poor quality control in imaging. This study discusses several types of artifacts and gives examples of these artifacts with emphasis on recognition of the artifact in the final image and correction of the problem.

43937 (CONF-8609383—, pp 46-50) **Practical aspects of quality assurance.** Henkin, R.E. Sep 1986. NTIS, PC A07/MF A01. Order Number DE88003984/JAW.

From Joint international symposium on SPECT in clinical practice; Washington, DC, USA (22 Sep 1986).

Many individuals operating clinical SPECT units have not taken the trouble to develop the appropriate quality assurance protocols to verify the correct operation, positioning and reconstruction of data. The result in many institutions is mass confusion. Artifacts run rampant and faith is lost in the system due to misdiagnosis. Without the availability of a quality control routine that is both adhered to and evaluated, the generation of clinically valid SPECT data is not possible. The author will list some of the considerations that need to be dealt with in developing such a system.

43938 (CONF-8609383—, pp 52) **Technical aspects - summation.** Oppenheim, B.E. Sep 1986. NTIS, PC A07/MF A01. Order Number DE88003984/JAW.

From Joint international symposium on SPECT in clinical practice; Washington, DC, USA (22 Sep 1986).

43939 (CONF-8609383—, pp 54-56) **Patient set-up for SPECT.** Croft, B.Y. Sep 1986. NTIS, PC A07/MF A01. Order Number DE88003984/JAW.

From Joint international symposium on SPECT in clinical practice; Washington, DC, USA (22 Sep 1986).

This study focuses on positioning and patient examination parameters in relation to single photon emission computed tomography. One problem of image processing in nuclear medicine is to collect the greatest number of counts with the best resolution with low radiation dose and patient comfort. The author examines these requires and its effect on the examination.

43940 (CONF-8609383—, pp 58-64) **Current advances in hepatic SPECT imaging.** Van Heertum, R.L. Sep 1986. NTIS, PC A07/MF A01. Order Number DE88003984/JAW.

From Joint international symposium on SPECT in clinical practice; Washington, DC, USA (22 Sep 1986).

Greater accuracy of SPECT imaging is primarily related to improved image contrast and better spatial resolution at increasing distances from the surface of the detector. The SPECT techniques appear to be most accurate in evaluation of liver disease when displayed and interpreted in at least three planes. This approach is particularly important in the evaluation of presence and extent of disease, as well as in the differentiation of intra-versus extra-hepatic disease. SPECT imaging of the liver compares quite well with transmission CAT scanning. The SPECT technique is superior to CAT in the evaluation of diffuse liver disease and is useful for the assessment of both superficial defects and deeper defects throughout the liver. CAT scanning is more useful for the assessment of the porta hepatis and for the evaluation of focal liver disease. The current approach is to recommend the SPECT examination as the first procedure for evaluation of focal and diffuse space-occupying liver disease. Those cases in need of additional diagnostic information are then referred for a CAT scan.

43941 (CONF-8609383—, pp 66-70) **Qualitative and quantitative hepatic SPECT imaging.** Ziessman, H.A. Sep 1986. NTIS, PC A07/MF A01. Order Number DE88003984/JAW.

From Joint international symposium on SPECT in clinical practice; Washington, DC, USA (22 Sep 1986).

SPECT has the potential to depict the 3 dimensional distribution of perfusion, separate out overlying activity and improve contrast resolution. The author reviewed 91 SPECT Tc-macroaggregated albumin (MAA) hepatic arterial perfusion studies on patients with various cancers metastatic to the liver: colon, carcinoid, hepatoma, cholangiocarcinoma, pancreatic and miscellaneous. All patients had angiography and planar Tc-99m Tc-SC liver-spleen scans. Twenty-six had SPECT Tc-SC studies. The planar Tc-MAA studies were initially interpreted prospectively over a 4 year period. At a later date they were reinterpreted retrospectively. The patient's TC-SC study was always used for comparison. All SPECT Tc-MAA studies were then reviewed and interpreted. If a Tc-SC SPECT study was available, it was used for comparison, otherwise the planar study was used. The results of this comparison are presented. In addition to providing improved qualitative information, SPECT has the potential for improved quantitative data compared to planar imaging. SPECT has enabled them to examine the in-vivo density of functional hepatic tumor microcirculation compared to that of normal liver.

43942 (CONF-8609383—, pp 72-86) **Functional brain imaging with perfusion tracers.** Hill, T.C. Sep 1986. NTIS, PC A07/MF A01. Order Number DE88003984/JAW.

From Joint international symposium on SPECT in clinical practice; Washington, DC, USA (22 Sep 1986).

The rapid development of single-photon radiopharmaceuticals for cerebral blood flow study - which reveals function instead of morphology - has given new life to tomographic brain imaging in nuclear medicine. Progress in radiopharmaceuticals and refinements in neuro-SPECT instrumentation are helping to reinstate brain scintigraphy as an important part of neurologic diagnosis.

43943 (CONF-8609383—, pp 88-96) **Dynamic brain imaging with SPECT.** Devous, M.D. Sep 1986. NTIS, PC A07/MF A01. Order Number DE88003984/JAW.

From Joint international symposium on SPECT in clinical practice; Washington, DC, USA (22 Sep 1986).

Single-photon emission computed tomography (SPECT) is a rapidly developing technology capable of making 3-dimensional measurements of cerebral physiology. Recent developments in radiopharmaceuticals and imaging instruments have made SPECT competitive with positron emission tomography (PET) in many aspects of functional brain imaging. It is now possible to make detailed measurements of regional cerebral blood flow (rCBF) and receptor function with instruments and radiopharmaceuticals that are practical for routine clinical application.

43944 (CONF-8609383—, pp 98-100) **SPECT in the quantitative imaging of radiolabeled antibodies.** Leichner, P. Sep 1986. NTIS, PC A07/MF A01. Order Number DE88003984/JAW.

From Joint international symposium on SPECT in clinical practice; Washington, DC, USA (22 Sep 1986).

The clinical advantages of SPECT imaging in radioimmunotherapy have included the following: tumor localization of radiolabeled antibodies is more easily visualized in transverse slices than in planar views, necrotic regions within large tumors may be detected with relative ease, and tumor-to-normal tissue ratios may be determined more reliably from SPECT slices than from planar views. These are important parameters that influence treatment decisions,

and as SPECT instrumentation and reconstruction algorithms continue to improve, SPECT imaging will play an increasingly important role in radioimmunotherapy treatment planning.

43946 (CONF-8609383—, pp 102-112) **SPECT imaging of the Thorax: emphasis on Ga-67 for tumor and infection.** Alazraki, N.P. Sep 1986. NTIS, PC A07/MF A01. Order Number DE88003984/JAW.

From Joint international symposium on SPECT in clinical practice; Washington, DC, USA (22 Sep 1986).

Planar imaging with Gallium 67 has always been complex and difficult, and SPECT further complicates those problems. To determine the best SPECT imaging parameters for gallium 67, they have done studies using a chest phantom, with lesions of 1.5cm x 1cm and 2.2cm diameter placed in the center of the phantom to simulate mediastinal tumors.

43946 (CONF-8609383—, pp 114-121) **Orthopedic applications of SPECT imaging.** Collier, B.D. Sep 1986. NTIS, PC A07/MF A01. Order Number DE88003984/JAW.

From Joint international symposium on SPECT in clinical practice; Washington, DC, USA (22 Sep 1986).

During the day-to-day operation of a busy nuclear medicine laboratory, the addition of SPECT to an orthopedic bone scanning procedure requires an extra 5 minutes for setup and patient positioning, 21 minutes for data acquisition, and 15 minutes for processing and filming. However, when examining patients with knee, hip, low back, and TMJ pain, SPECT bone scanning frequently gives images of greater clarity and in many instances provides unique diagnostic information. Specific advantages of SPECT in identifying and localizing skeletal pathology already have been established, and further diagnostic applications both for skeletal oncology and for the study of low back pain are anticipated.

43947 (CONF-8609383—, pp 123-134) **SPECT studies of the heart.** Berger, H.J. Sep 1986. NTIS, PC A07/MF A01. Order Number DE88003984/JAW.

From Joint international symposium on SPECT in clinical practice; Washington, DC, USA (22 Sep 1986).

Routine planar thallium-201 imaging results in superimposition of myocardial regions. Small defects and/or multiple defects may be obscured because of overlap with normal regions. Furthermore, with a routine three view planar thallium-201 study, the entire myocardium is not visualized. It is for these reasons that single photon emission computed tomography was developed and applied to myocardial perfusion imaging. There is the potential for avoidance of such areas of regional overlap and thus accurate definition of multiple areas of regional ischemia.

43948 (CONF-8609383—, pp 136-137) **SPECT-T1-201 cardiac imaging.** Berman, D.S. Sep 1986. NTIS, PC A07/MF A01. Order Number DE88003984/JAW.

From Joint international symposium on SPECT in clinical practice; Washington, DC, USA (22 Sep 1986).

Topics of discussion include: limitations of planar thallium-201 imaging; tomographic acquisition protocol; quantitative analysis involving slice selection, circumferential profile generation, comparison to normal limits and polar display of results; sensitivity and specificity; sources of error involving patient motion and upward creep; and clinical applications.

43949 (CONF-8609383—, pp 139) **Organ imaging - summation.** Croft, B.Y. Sep 1986. NTIS, PC A07/MF A01. Order Number DE88003984/JAW.

From Joint international symposium on SPECT in clinical practice; Washington, DC, USA (22 Sep 1986).

43950 (INIS-mf—11210, pp VII5-VII8) **On the use of ^{56}Co in nuclear medicine - its disadvantage and why ^{57}Ni is preferable.** Alfassi, Z.B.; Weinreich, R. (Ben-Gurion Univ. of the Negev, Beersheba (Israel). Dept. of Nuclear Engineering; Eidgenoessisches Inst. fuer Reaktorforschung, Wuerenlingen (Switzerland)). Dec 1987. NTIS (US Sales Only), PC A13/MF A01. Order Number DE88780087/JAW. (CONF-871287—).

From Nuclear Societies of Israel annual meeting; Haifa, Israel (21 Dec 1987).

Transactions.; V. 14.

43951 (INIS-mf—11210, pp VII18-VII20) **Multifield total skin irradiation.** Mandelzweig, Y.; Sapir, D.; Yudelev, M.; Tatcher, M. (Rambam Government Hospital, Haifa (Israel)). Dec 1987. NTIS (US Sales Only), PC A13/MF A01. Order Number DE88780087/JAW. (CONF-871287—).

From Nuclear Societies of Israel annual meeting; Haifa, Israel (21 Dec 1987).

Transactions.; V. 14.

43952 **(ISS-T—86-2) Radiation protection criteria in the use of radioactive sources for brachytherapy.** Bartolotta, A.; Belli, M.; Matzeu, M.; Onori, S. (Istituto Superiore di Sanita, Rome (Italy)). 1986. 88p. (In Italian). NTIS (US Sales Only), PC A05/MF A01. Order Number DE88701761/JAW.

This paper reports the criteria to be used to ensure radiation protection in the use of radioactive sources for brachytherapy. It is intended as a guide for licencing authorities and for applications.

43953 **A multichannel, high linearity current digitizer for digital subtraction angiography.** Nakamura, M.; Katz, J.E.; Thompson, A.C. (Center for X-Ray Optics, Lawrence Berkeley Lab., Berkeley, CA (US)). *IEEE (Institute of Electrical and Electronics Engineers) Transactions on Nuclear Science;* **35**: No. 1, 205-208(Feb 1988). (CONF-871006—).

From 34. nuclear science symposium and 19. nuclear power systems symposium; San Francisco, CA, USA (21 Oct 1987).

An experiment studying the application of synchrotron radiation for transvenous coronary angiography requires special electronics to read out a 600 element Si(Li) detector. To obtain high image quality, the electronic system must digitize the current in all 600 elements every 2 ms with a dynamic range of 40,000 and a maximum non-linearity of 0.02%. Each channel of electronics contains a current-to-voltage amplifier with computer controlled gain and offset followed by a voltage-to-frequency converter used in the reciprocal accounting mode. A high speed digital readout method using a lookup table, digital multiplier and direct memory interface was developed. The entire system has been designed to have a low cost per channel and to be easily expanded to 1200 signal channels.

43954 **Animal models of human disease.** Som, P.; Oster, Z.H. (Brookhaven National Lab., Upton, NY (US)). pp 333-356 of Essentials of nuclear medicine science. Hladik, W.B. III; Saha, G.B.; Study, K.T. Baltimore, MD; Williams and Wilkens (1987).

Animal models are used for the study of the normal metabolism and physiological processes as well as for the study of disease processes in humans. It is taken for granted that results obtained from experiments on animals which, in the phylogenetic scale, are close to humans, are more applicable than are results obtained from species that are more remote phylogenetically. Many conditions can be studied in rodents or other small animals, however, and the results obtained can still be valid for human conditions. It is the thorough knowledge of the anatomical and physiological variations of species that enables the choice of the appropriate animal model which will yield information that is statistically significant, is economical, and can be applied to the human in health and disease.

5507 Microbiology

REFER ALSO TO CITATION(S) 42582, 42930, 42931

5510 Physiological Systems

REFER ALSO TO CITATION(S) 43929

5530 Agriculture And Food Technology

REFER ALSO TO CITATION(S) 42892, 42903, 42916, 43203, 43210, 43427

43955 (CEA-CONF—9229) Present status of the dosimetric control of food irradiation in France. Laizier, J.; Mosse, D. (CEA Centre d'Etudes Nucleaires de Saclay, 91 - Gif-sur-Yvette (France). Office des Rayonnements Ionisants). 1986. 6p. (CONF-8611252—). NTIS (US Sales Only), PC A02/MF A01. Order Number DE88753907/JAW.

From Working group on health impact and control methods of irradiated foods; Neuherberg, F.R. Germany (17 Nov 1986).

The irradiation of food arises much interest in France, although the process is still industrially used to a very limited extend, but every facts indicate a strong trend to the development of the uses. This arises new problems of dosimetric control. The efforts of the few last years to overcome those problems were focused along two axis: the development of a code of good practice and that of using more widely the alanine dosimeter.

43956 (INIS-mf—11210, pp VII21-VII24) Recent developments in the radiation sterilization of pharmaceuticals. Jacobs, G.P. (Hebrew Univ., Jerusalem (Israel). School of Pharmacy). Dec 1987. NTIS (US Sales Only), PC A13/MF A01. Order Number DE88780087/JAW. (CONF-871287—).

From Nuclear Societies of Israel annual meeting; Haifa, Israel (21 Dec 1987).

Transactions.; V. 14.

56 BIOMEDICAL SCIENCES, APPLIED STUDIES

REFER ALSO TO CITATION(S) 43923

5601 Radiation Effects

REFER ALSO TO CITATION(S) 43869

43957 (DOE/ER/60393—3) Mutagenic effect of tritium on DNA of Drosophila melanogaster. Comprehensive performance report, December 15, 1985-June 1, 1988. Lee, W.R. (Louisiana State Univ., Baton Rouge (USA). Dept. of Zoology and Physiology). 1988. Contract FG05-86ER60393. 10p. NTIS, PC A02/MF A01; 1; GPO Dep. Order Number DE88012216/JAW.

The results of the RBE determination of tritium to cobalt-69 gamma radiation along with a description of methods of treatment and dose determination are given. Using the described procedures for exposing Drosophila to tritiated water, the authors induced mutations by tritium beta radiation and recovered them at the Adh locus.

43958 (DP—1758) Environmental effects of the July 31, 1987 tritium release from the Savannah River Plant. Kurzeja, R.J.; Taylor, R.W.; Sharma, J.; Burckhalter, L.T. (Du Pont de Nemours (E.I.) and Co., Aiken, SC (USA). Savannah River Lab.). Oct 1987. Contract AC09-76SR00001. 38p. NTIS, PC A03/MF A01;1; GPO Dep. Order Number DE88012238/JAW.

An unplanned release of tritium fron the Savannah River Plant occurred on July 31, 1987 from 9:17 to 9:55 a.m. EDT. The total release of elemental tritium and tritium oxide was 172,000 Ci. The initial estimate of the ratio of tritium oxide to total tritium was 11% (19,000 Ci), and the corresponding maximum dose to a person at the plant boundary was estimated to be 0.2 mrem. Later data indicated that the percent tritium oxide was 2.7% (4700 Ci) and the estimated maximum dose at the plant boundary was revised downward to 0.02 mrem. The population dose was estimated to be 0.22 person-rem. 4 refs., 15 figs., 9 tabs.

43959 (INIS-mf—11210, pp I14-I15) Challange of developing radioprotective and photoprotective drugs. Riklis, E.; Kol, R.; Green, M. (Israel Atomic Energy Commission, Beersheba. Nuclear Research Center-Negev). Dec 1987. NTIS (US Sales Only), PC A13/MF A01. Order Number DE88780087/JAW. (CONF-871287—).

From Nuclear Societies of Israel annual meeting; Haifa, Israel (21 Dec 1987).

Transactions.; V. 14.

43960 (INIS-mf—11210, pp VII14-VII17) Adaptive assay of radioactive pulmonary aerosol with an external detector. Talmor, A.; Leichter, Y.; Ben-Haim, Y.; Kushelevsky, A. (Israel Atomic Energy Commission, Beersheba. Nuclear Research Center-Negev; Technion-Israel Inst. of Tech., Haifa. Dept. of Nuclear Engineering; Ben-Gurion Univ. of the Negev, Beersheba (Israel). Dept. of Nuclear Engineering). Dec 1987. NTIS (US Sales Only), PC A13/MF A01. Order Number DE88780087/JAW. (CONF-871287—).

From Nuclear Societies of Israel annual meeting; Haifa, Israel (21 Dec 1987).

Transactions.; V. 14.

43961 (INIS-mf—11210, pp VII25-VII31) Portal film charts for a 6mev linear acceleration. Faermann, S.; Regev, E.; Leser, Y. (Soroka Medical Center, Beersheba (Israel). Dept. of Oncology; Beilinson Hospital, Petah Tiqva (Israel). Dept. of Oncology). Dec 1987. NTIS (US Sales Only), PC A13/MF A01. Order Number DE88780087/JAW. (CONF-871287—).

From Nuclear Societies of Israel annual meeting; Haifa, Israel (21 Dec 1987).

Transactions.; V. 14.

43962 (JINR-E—19-87-858) Induction of revertants by heavy particles and gamma-rays in salmonella tester strains. Kozubek, S.; Krasavin, E.A.; Amirtaev, K.G.; Tokarova, B.; Bonev, M.; Soska, J.; Drasil, V. (Joint Inst. for Nuclear Research, Dubna (USSR). Lab. of Nuclear Problems; Ceskoslovenska Akademie Ved, Brno. Biofysikalni Ustav). (Joint Inst. for Nuclear Research, Dubna (USSR). Lab. of Nuclear Problems). 1987. 12p. NTIS (US Sales Only), PC A03/MF A01. Order Number DE88703710/JAW.

Submitted to the journal Mutat. Res. .

Mutagenic effect of different types of ionizing radiations has been investigated in Salmonella tester strains. The effectiveness of ionizing radiation decreased with increasing LET in the TA 98 strain. No marked decrease could be detected in the TA 100 and TA 102 strains. The results suggest that at least two different types of permutational DNA injuries are produced by ionizing radiation - the first is produced by γ-rays and leads to frameshifts, the second is produced by heavy particles and leads to substitutions. 10 refs.; 4 figs.

43963 (KURRI-TR—290, pp 7-15) Proposed model for the transfer of environmental tritium to man and tritium metabolism in model animals. Saito, Masahiro; Ishida, M.R. (Kyoto Univ., Kumatori, Osaka (Japan). Research Reactor Inst.). Jun 1987. (In Japanese). NTIS (US Sales Only), PC A05/MF A01. Order Number DE88780086/JAW. (CONF-8607368—).

From Short-term conference on biological transformation of radionuclides in the environment and dose assessment; Kumatori, Japan (23 Jul 1986).

To evaluate the accumulated dose in human bodies due to the environmental tritium, it is of required to establish an adequate model for the tritium transfer from the environment to man and to obtain enough information on the metabolic behaviour of tritium in animal bodies using model animal system. In this report, first we describe about a proposed model for the transfer of environmental tritium to man and secondly mention briefly about the recent works

on the tritium metabolism in newborn animals which have been treated as a model system of tritium intake through food chain.

43964 (KURRI-TR—290, pp 16-22) **Distribution and behaviors of some long-lived radionuclides in the environment.** Ikeda, Nagao. (Tsukuba Univ., Sakura, Ibaraki (Japan)). Jun 1987. (In Japanese). NTIS (US Sales Only), PC A05/MF A01. Order Number DE88780086/JAW. (CONF-8607368—).

From Short-term conference on biological transformation of radionuclides in the environment and dose assessment; Kumatori, Japan (23 Jul 1986).

Among various long-lived radionuclides in the environment, the distribution and behaviors of uranium in human tissues and ^{129}I in soil were studied by the fission track method and neutron activation method, respectively. It was shown that uranium concentration was higher in lungs (av. 1.86 ppb wet) than in kidney (0.35 ppb) or liver (0.26 ppb). The ^{129}I contents in some soil samples collected in Ibaraki Pref. were found in the range of $10^{-7} \sim 10^{-5}$ Bqg soil.

43965 (KURRI-TR—290, pp 46-51) **Ingestion of actinide elements from marine products.** Hisamatsu, Shun-ichi. (Akita Univ. (Japan). School of Medicine). Jun 1987. (In Japanese). NTIS (US Sales Only), PC A05/MF A01. Order Number DE88780086/JAW. (CONF-8607368—).

From Short-term conference on biological transformation of radionuclides in the environment and dose assessment; Kumatori, Japan (23 Jul 1986).

According to our recent study, the contribution of ingested Pu from algae was the highest among the food groups studied : approximately 60 % of the total ingested Pu during 1962, and 74 % in 1983 - 84. The contribution from whole marine products, i.e. algae and fishshellfish, was approximately 70 % of the total Pu ingested in 1962, and over 90 % in 1983 - 84. In the cases of U and Am, the marine products also play important role to total ingestion of those elements. However, the f_1 value for actinide elements in marine organisms is not known. The research concerning the f_1 value for ingested actinide generally does not advance in comparison with that for inhaled actinide. The recent topics, especially for biologically incorporated Pu and Am, were reviewed in present report.

43966 (PB—88-208889/XAB) **Report of the National Institutes of Health Ad Hoc Working Group to develop radioepidemiological tables.** (National Institutes of Health, Bethesda, MD (USA)). Jan 1985. 363p. (NIH/PUB—85-2748). NTIS, PC A16/MF A01.

Also Available from Supt. of Docs. See also PB—86-210200.

Public Law 97-414, the Orphan Drug Act, passed by Congress and enacted on Jan. 4, 1983, directed the Secretary of HHS to construct radioepidemiological tables showing the probability that certain cancers could result from prior exposure to radiation. The Ad Hoc Working Group together with several other organizations collaborated to establish the tables.

43967 (TsNIIATOMINFORM-ON—1-87) **Proposals for setting possible limits on intake of transuranium radionuclides absorbed from the gastrointestinal tract.** Zalikin, G.A.; Nisimov, P.G. (Gosudarstvennyj Komitet po Ispol'zovaniyu Atomnoj Ehnergii SSSR, Moscow; Ministerstvo Zdravookhraneniya SSSR, Moscow. Natsional'naya Komissiya po Radiatsionnoj Zashchite). 1987. 52p. (In Russian). NTIS (US Sales Only), PC A04/MF A01. Order Number DE88703806/JAW.

The absorption of transuranium elements (/sup 238/Pu, /sup 241/Am, /sup 252/Cf) from the gastrointestinal (GI) tract as influenced by physiological factors (e.g. age) and physical and chemical properties of compounds incorporated has been studied in 600 white mongrel rats. Average values of absorption have been determined for simple salts and a complex citrate. A number of factors increasing absorption have been found. Thus, originally bound compounds contained in the meat of animals incorporated with /sup 238/Pu and /sup 241/Am when alive, /sup 241/Am-containing potato juice and green oat stalks enhanced absorption by a factor of 5 to 30 as compared with an adequate control. Ethanol administered orally as a 20% solution increased the absorption of americium nitrate by 60% and that of citrate by 23%. Oral administratio of /sup 241/Am nitrate solution together with ferric chloride changes the metabolic kinetics of the nuclide completely. The total absorption of americium from DI tract is 7.1 times that of the control, but a considerable fraction absorbed into blood is excreted with urine (4.2% over 8 days). Among physiological factors age effects the absorption of transuranics from the GI tract to acertain degree. The absorption of /sup 252/Cf in 7 day-old young rats proves to be 8.1 times that of adults. Gestation brought about a 2.7 fold increase of /sup 241/Am absorption. 15 refs.; 2 figs.; 17 tabs.

43968 (TsNIIATOMINFORM-ON—2-86) **Genetic effects of radionuclide decay.** Korolev, V.G.; Gracheva, L.M.; Ivanov, E.L. (Gosudarstvennyj Komitet po Ispol'zovaniyu Atomnoj Ehnergii SSSR, Moscow; Ministerstvo Zdravookhraneniya SSSR, Moscow. Natsional'naya Komissiya po Radiatsionnoj Zashchite). 1986. 28p. (In Russian). NTIS (US Sales Only), PC A03/MF A01. Order Number DE88703807/JAW.

Experiments with /sup 3/H decay incorporated into different positions of nitrogen bases of yeast DNA have shown that alternations in chemical structure of DNA nucleotides are not lethal damages to cells. However, some of these alternations may be strongly mutagenic. Among latters are products of dehydration of 5-th position of cytosine and 8-th position of guanine in DNA. Two DNA strands damaged at adjasent sites are of drastic genetic activity. DNA double strand breaks inactive cells very effectively. An another type of similar damages results frequently from the /sup 32/P decay. In this case one DNA strand breaks and the other is somehow damaged at the opposite site. Such "adjacent" lesions are highly lethal and mutagenic. There is a strong correlation of mutagenic efficiency upon the transmutation enrgy of radionuclide bound in some way with as transmutation energy increses. 31 refs.; 5 figs.; 4 tabs.

43969 (TsNIIATOMINFORM-ON—3-86) **Acute radiation effects in man.** Barabanova, A.V.; Baranov, A.E.; Gus'kova, A.K.; Kejrim-Markus, I.B.; Moiseev, A.A.; Pyatkin, E.K.; Red'kin, V.V.; Suvorova, L.A. (Gosudarstvennyj Komitet po Ispol'zovaniyu Atomnoj Ehnergii SSSR, Moscow; Ministerstvo Zdravookhraneniya SSSR, Moscow. Natsional'naya Komissiya po Radiatsionnoj Zashchite). 1986. 78p. (In Russian). NTIS (US Sales Only), PC A05/MF A01. Order Number DE88703808/JAW.

The publications concerning human acute irradiation effects have been summed up and generalized. Fifty eight acute radiation sickness incidences from external sources due to radiation accidents and a great deal of data about total therapeutic irradiation of patients have been analysed. The effects connected with bone marrow radiation syndrome have been studied more detaily. A special part is devoted to the possible acute effects initiation due to human intake of radionuclides. The observations are systematized and damage clinical picture is described in accordance with the radiation sickness classification given by Guskova A.K. and Baisogolov G.D. and accepted in the USSR. The present state of acute dose estimate and human midlethal dose problem has been shown. As for the given data amount and the fullness of information generalized. 115 refs.; 23 figs.; 3 tabs.

43970 **Mastoid carcinoma 52 years after childhood intake of ^{226}Ra in a man retaining 1 kBq: estimation of skeletal dose.** Keane, A.T.; Mays, C.W. (Argonne National Lab., IL (USA); National Cancer Inst., Bethesda, MD (USA)). *Radiation Protection Dosimetry;* **21**: No. 4, 197-203(1988). Contract W-31-109-ENG-38;AC02-76EV00119.

Body ^{226}Ra activity monitored periodically in the interval from 23 y to 51 y after intake remained virtually constant at about 1 kBq in a man who developed a mastoid carcinoma 52 y after ingesting a tonic containing radium salts at age 6-8 y. The skeletal dose at the time of tumour diagnosis, estimated to be within a factor of two of 1.2 Gy, was less than the lowest skeletal dose (4.6 Gy) estimated for the 88 U.S. persons measured for radium body content who developed malignancies of bone or of the paranasal sinuses or mastoid air-cells following exposure as adolescents or adults to ^{226}Ra or to mixtures of ^{226}Ra and ^{228}Ra.

5603 Chemicals Metabolism And Toxicology

REFER ALSO TO CITATION(S) 42620, 42699, 42896, 42897, 42898, 42899, 42900, 42901, 43457, 43458, 43846, 43906

43971 (CONF-880596—1) Sampling and chemical characterization of workplace atmospheres contaminated with airborne diesel exhaust. Jenkins, R.A.; Griest, W.H.; Moneyhun, J.H.; Tomkins, B.A.; Ilgner, R.H.; Higgins, C.E.; Gayle, T.M. (Oak Ridge National Lab., TN (USA)). 1988. Contract AC05-84OR21400. 14p. NTIS, PC A03;3. Order Number DE88010136/JAW.

From EPA/APCA symposium on measurement of toxic and related air pollutants; Raleigh, NC, USA (2 May 1988).

The chemical composition of workplace atmospheres contaminated with diesel exhaust appear to be exceedingly complex. Building to building differences occur even though the fuel source for vehicles operating in such a facility are identical. There appear to be substantial differences between the particle size distributions of workplace atmospheres and that of those sources which contaminate them. Long duration sampling tends to alter the apparent composition of the collected particle phase, and composite samples of shorter duration may enhance compositional accuracy. Diluted idling large vehicle engine exhaust is probably not a compositionally accurate surrogate for workplace atmospheres for inhalation toxicology studies.

43972 (DOE/CE/15270—T6) Explorations of mechanisms regulating ectomycorrhizal colonization of boron-fertilized pine. Quarterly report, April 1, 1988-June 30, 1988. Garrett, H.E.; Reid, R.K.; Sword, M.A. (Missouri Univ., Columbia (USA). School of Forestry, Fisheries and Wildlife). 1988. Contract FG01-86CE15270. 19p. NTIS, PC A03/MF A01; 1; GPO Dep. Order Number DE88012258/JAW.

The task undertaken during the period of this progress report was to evaluate ectomycorrhizal-created endogenous increases of auxin (IAA) in shortleaf pine root systems receiving boron supplements and to determine if the impact on carbohydrate flux resembles that in plants receiving exogenous boron and IAA. In this report, analysis of the root system C^{14} is described. Contrary to expectations, B addition caused the C^{14} activity in the roots to decrease. Also reported on was a study to evaluate the effectiveness of phenolase in metabolizing toxic phenolic compounds and a study to determine the types and quantities of phenolic compounds produced by pine seedlings inoculated with Pisolithus tinctorius and receiving boron fertilization.

43973 (DOE/EV/02040—T4) Mutational specificity in mammalian cells: Progress report for period February 1, 1987-January 31, 1988: [Final report]. Strauss, B.S. (Chicago Univ., IL (USA)). 29 Mar 1988. Contract AC02-76EV02040. 12p. NTIS, PC A03/MF A01;1; GPO Dep. Order Number DE88008478/JAW.

This paper discusses the termination of in vitro DNA synthesis where the nature of the lesion as well as the polymerase determine the specificity of base inserted opposite the lesion. We confirmed the A rule at abasic sites produced by the removal of cytosine from the DNA. Treatment of SNA with dimethylsulfate or N-methyl-N'-nitro-N-nitrosoguanidine leads to transcription termination at site of the immediately preceding A indicating that methylated G's are not blocks and supporting that 3-methyladenine is a lethal lesion where DNA synthesis terminates. By using both uv- and methylation lesions, the rules for termination worked out using single stranded DNA molecules as templates were shown to hold for double stranded substrates. A system for measurement of mutation using a M13 vector containing a lac complementing insert and a uracil containing ({plus}) strand annealed to a normal ({minus}) strand but without the insert so that the lac complementing region forms a single stranded gap was developed. 3 figs., 4 tabs.

43974 (GSF—11/87) Catalogue of the Bavarian environmental monitoring programme. As of March 1987. Behling, G. (Gesellschaft fuer Strahlen- und Umweltforschung m.b.H. Muenchen, Neuherberg (Germany, F.R.)). 1987. 130p. (In German). NTIS (US Sales Only), PC A07. Order Number DE88753778/JAW.

The project was initiated in 1985; its goal was the early detection and assessment of environmental effects so as to enable early scientific measures to be taken and provide a better basis for decision-making. The project comprised the acquisition and processing of relevant data, the development and use of key indicators, and studies on specific problems. (orig./KG)

43975 (KFK-PEF—37) Microorganisms as biological indicators for forest damaging air-pollutants. Waldner-Sander, S.; Botzenhart, K. (Tuebingen Univ. (Germany, F.R.). Abt. fuer Allgemeine Hygiene und Umwelthygiene). (Kernforschungszentrum Karlsruhe G.m.b.H. (Germany, F.R.). Projekt Europaeisches Forschungszentrum fuer Massnahmen zur Luftre). Jun 1987. 66p. (In German). NTIS (US Sales Only), PC A04. Order Number DE88753785/JAW.

For the application of microorganisms as bioindicators for airborne pollutants a method could be developed using different procaryotic and eucaryotic microorganisms on membrane filters for exposure in the open air. The feasibility of the method on a larger scale seems to be possible. Differences in the toxicity of the air at several measuring sites and also effects of noxes on the die-off kinetics, caused by climate and emissions, of the microorganisms could be obtained. The examination of the bacterial and fungal populations on leaf and needle surfaces showed several influencing parameters: season, climate, site, position at the tree. Spruces of higher damage degrees, especially yellowed, showed increased numbers of organisms and species. (orig.) With 34 figs., 16 tabs., 38 refs.

43976 (NP—8770251) Effect of thallium in cement oven dusts on the growth and thallium uptake of several culture plants for the determination of thallium thresholds in plants and soils. Makridis, H. (Technische Univ. Muenchen, Freising (Germany, F.R.). Fakultaet fuer Landwirtschaft und Gartenbau). 27 Feb 1987. 192p. (In German). NTIS (US Sales Only), PC A09. Order Number DE88770251/JAW.

After preliminary experiments in the methodology of Tl-analysis in plants and soils, phytotoxic Tl-concentrations and specific toxicity symptoms of different crops (beans, rape) have been determined in hydroponic culture with TlCl/sub 3/.H/sub 2/O. In pot experiments, critical Tl-levels were evaluated with regard to yield and Tl-uptake of plants on different soils, as a basis for the classification of soilcontamination by Tl originating form cement klink dust. The latter is a main source of Tl-emissions. Thus, several dusts with differing Tl-concentrations were tested in extensive two-year pot-experiments with different plants, and critical levels for lime- and potash- containing dusts have been elaborated. (orig./MG)

43977 (NP—8770255) Criteria for biological monitoring of environmental pollutants (the example of benzene). Eikmann, T. (Technische Hochschule Aachen (Germany, F.R.). Medizinische Fakultaet). 1 Dec 1986. 192p. (In German). NTIS (US Sales Only), PC A09. Order Number DE88770255/JAW.

Three parameters are recommended for biological monitoring of persons exposed to benzene in accordance with the results of the Paris Internatonal Workshop on Toxicology of Benzene, 1976: 1. Benzene concentrations in the exhaled air; 2. Benzene levels in blood; 3. Urinary excretion of phenol as a benzene metabolite. The three recommended biological monitoring parameters were tested in theoretical studies, animal experiments, clinical studies and especially in epidemiological studies in order to assess their applicability in environmental medicine. The studies were also to provide general information on the population exposure to this carcinogenic. (orig./MG)

43978 (NP—8770258) Biological effects of a flue gas desulfurization gypsum produced by the limestone process. Bartmann, C. (Technische Hochschule Aachen (Germany, F.R.). Medizinische Fakultaet). 26 Jun 1986. 83p. (In German). NTIS (US Sales Only), PC A05. Order Number DE88770258/JAW.

'Flue gas gypsum', which will be produced in large amounts in the future, high-efficiency desulfurisation processes must be in-

vestigated with a view to its effects on human health, especially the potentially toxic effect on the lungs. All animals in the experiment were given a single intratracheal dose of 25 mg dust in 0.5 ml isotonic sodium chloride solution. The animals were examined at intervals of one day or one to 18 months. No dust was discovered in the light microscope after 24 h, and no clearly pathological reaction was found within a period of 18 months. None of the histological preparations showed signs of incipient gramuloma of fibrosis of the lungs. A chemical analysis using flameless atomic absorption spectrometry showed no increased concentrations of Al, Cr, and Ni in the parenchymatons organs (lungs, kidneys, livers). Lead was rapidly accumulated in the fermur at the onset of the experiments and was eliminated in the course of 18 months. A mutagenicity test according to Ames proved the applied dust to be clearly non-metagenic. The dust used in the experiment can thus be assumed to be largely inert. Still, it should not be considered completely safe, as the risk of permanent or intermittent exposure was left out of account in the experiment. (orig./MG)

43979 **(NP—8770265) Biological indicating of polycyclic aromatic hydrocarbons in the extended area of Frankfurt/Main.** Poos, F. (Giessen Univ. (Germany, F.R.)). 24 Jun 1985. 140p. (In German). NTIS (US Sales Only), PC A07/MF A01. Order Number DE88770265/JAW.

The work presents a method for the treatment of plant material and the qualitative and quantitative verification of polycyclic aromatic hydrocarbons by gas chromatography. The results indicate that the centre of the city of Frankfurt has to cope with a pollution burden 3 to 5 times as high as the surrounding territory. The ratios of the 13 pollution components are largely identical at all sampling points. The leaf surface seems to be the decisive morphological quantity determining the degree of contamination. To be sure, different plant species do sustain different pollution leads per unit of weights, but the load per unit of leaf surface is largely the same. (orig./KG)

43980 **(NP—8770266) Influence of dietary protein on the damage effect of Cd in rats.** Wagner, N. (Giessen Univ. (Germany, F.R.). Fachbereich Ernaehrungswissenschaften). 29 May 1985. 231p. (In German). NTIS (US Sales Only), PC A11/MF A01. Order Number DE88770266/JAW.

The influence of qualitative and quantitative variations in protein supply on the lesions effected by Cd were investigated in rats, with particular regard to Thio-AS supply. The results suggest that Thio-AS, and in particular cystein, has a strong effect on the Cd metabolism which is interpreted in terms of its influence on the synthesis of metallothionein. The effects of Cd are reduced by sufficient amounts of high-grade dietary protein. (orig./KG)

43981 **(NP—8770267) Animal experiments in order to determine the effects of Cd on parameters of the reticuloendothelial and hematopoietic system and on the distribution of essential metals in different organs.** Goetz, G. (Heidelberg Univ. (Germany, F.R.). Naturwissenschaftlich-Mathematische Gesamtfakultaet). 28 May 1985. 116p. (In German). NTIS (US Sales Only), PC A06/MF A01. Order Number DE88770267/JAW.

Mice and rats were given low doses of Cd with their drinking water, so that no external signs of intoxication were observed, and the Cd concentrations in different organs were measured after exposure periods of 10, 20, 40 and 90 days for mice and 30 and 90 days for rats. In the mice, also the Zn, Cu, Mn and Fe concentrations were determined in order to define the influence of Cd on the metabolism of these essential elements. In order to assess the possibility of Cd redistribution, Cd was discontinued in mice after 90 days, and the Cd concentrations in the liver and kidneys were measured after 30 and 90 days off Cd. The possible effect of Cd on various immune parameters of mice was investigated. The results of the investigation are presented and discussed. (orig./KG)

43982 **(NP—8770269) Investigations into the effects of age and food composition on the apparent absorption and retention of lead, calcium and phosphorus in juvenile rats.** Adler, G. (Hohenheim Univ., Stuttgart (Germany, F.R.). Fakultaet 4 - Agrarwissenschaften 2). 8 Jun 1982. 148p. (In German). NTIS (US Sales Only), PC A07/MF A01. Order Number DE88770269/JAW.

The changes in the lead balance with different lead concentrations in the food rations and with the type and amount of two different food fats were determined in three experiments with rats. The uptake with food and the excretion in urine and faeces were measured for lead, calcium and phosphorus in order to determine possible interdependences. The lead retention pattern was determined by organ analyses of the femur, liver, spleen, and kidneys. The findings are presented. The possible causes of the high apparent lead absorption are discussed in consideration of 1. the type of lead binding, 2. the lead concentration in food, 3. the animals' age, and 4. the quality and quantity of fat contained in the food. The effect of high concentrations of beef suet in food on the lead retention and the apparent absorption of phosphorus is discussed. (orig./KG)

43983 **(ORNL—6489) The role of health-based criteria development in USATHAMA's [US Army Toxic and Hazardous Materials Agency] Installation Restoration Program: Final report.** Etnier, E.L. (Oak Ridge National Lab., TN (USA)). Jun 1988. Contract AC05-84OR21400. 27p. NTIS, PC A03/MF A01; 1; GPO Dep. Order Number DE88013223/JAW.

The purpose of this report is to provide the Project Managers (PM) of the US Army Toxic and Hazardous Materials Agency (USATHAMA) Installation Restoration Program (IRP) with an overview of the means by which various health-based criteria and standards are derived and with definitions of health risk terms frequently used in the risk assessment/risk management scheme. Although certain chemical-specific criteria or standards may apply directly to ambient conditions at a hazardous waste site, many require adjustment to make them revelant and appropriate to the exposure conditions found at a particular site. This report will provide insight into the means of adjusting available health-based information to provide guidance on cleanup of waste sites and will give examples to clarify the methodologies. In particular, basic concepts for derivation of health-based standards and criteria for systemic toxicants and carcinogens are discussed, as well as the actual standards and criteria themselves. These include maximum contaminant level goals, maximum contaminant levels, drinking water health advisories, and ambient water quality criteria for the protection of human health. It can be seen that several basic precepts are inherent in each of the methodologies described, and an understanding of these basic concepts will allow the IRP PM to evaluate the chemical-specific ARARs developed for cleanup of any CERCLA site. 8 refs., 2 tabs.

43984 **Lung retention of diesel soot and associated organic compounds.** Wolff, R.K.; Henderson, R.F.; Snipes, M.B.; Sun, J.D.; Bond, J.A.; Mitchell, C.E.; Mauderly, J.L.; McClellan, R.O. (Inhalation Toxicology Research Institute, Lovelace Biomedical and Environmental Research Institute, P.O. Box 5890, Albuquerque, NM (US)). pp 199-212 of Carcinogenic and mutagenic effects of diesel engine exhaust. Ishinishi, N.; Koizumi, A.; McClellan, R.O.; Stober, W. New York, NY; Elsevier Science Pub. Co. Inc. (1986). (CONF-8607363—).

From International satellite symposium on toxicological effects of emissions from diesel engines; Tsukuba Science City, Japan (26 Jul 1986).

It has recently been shown that inhalation of high levels of diesel exhaust can produce lung tumors in rats. The particulate phase, consisting of carbonaceous particles with adsorbed organic compounds, appears to be particularly important because exposure to the gas phase has not resulted in tumors. Therefore, knowledge of the fate of both the particles and adsorbed organic compounds will aid in determining mechanisms responsible for lung tumor induction. Accumulations of diesel soot in lungs of rodents exposed to diesel exhaust has been a predominant feature of long-term exposures. Impaired clearance of particles has also been an important feature of diesel exhaust exposures and appears to be a prime reason for the accumulations of large lung burdens of diesel soot. Available data are examined in this paper to provide insights into dose-response relationships, i.e., exposure conditions that are likely to produce impaired particle clearance and adverse health effects.

57 HEALTH AND SAFETY

43985 **(UCID—21416) Safety analysis of the existing 825, 826 and 827 chemistry facilities.** Odell, B. (comp.). (Lawrence Livermore National Lab., CA (USA)). 31 May 1988. Contract W-7405-ENG-48. 117p. NTIS, PC A06/MF A01;1; GPO Dep. Order Number DE88012244/JAW.

A safety analysis was performed to determine if normal operations and/or potential accidents at the 825, 826, and 827 facilities at Site 300 could present undue hazards to the general public, personnel at Site 300, or have an adverse effect on the environment. It was determined by this analysis that all but one of the hazards were either low or of the type or magnitude routinely encountered and/or accepted by the public. The exception was explosives, which was classified as a moderate hazard per the requirements given in DOE Order 5481.1B. This safety analysis concluded that the operation at these facilities will present no undue risk to the health and safety of LLNL employees or the public nor have an adverse effect on the environment. 7 refs., 28 figs., 6 tabs.

43986 **(WHC-SA—0043) Radiation around us.** Moss, K.J. (Westinghouse Hanford Co., Richland, WA (USA)). Apr 1988. Contract AC06-87RL10930. 27p. NTIS, PC A03/MF A01; 1; GPO Dep. Order Number DE88012288/JAW.

Radiation Around Us is a presentation given to the public by qualified Hanford Speakers Bureau members. The slides and demonstrations in the presentation support the Hanford Site effort to provide expert, accurate information about radiation-related topics, which are often misunderstood. Depending on audience needs, the presentation can be given in its entirety or in parts. The slides present explanations of sources, consequences, and risks associated with radiation found in our environment. Demonstrations utilize the radioactive source kit and Geiger-Mueller instrument (GM); flashlight; chalkdust; protective clothing, lantern mantle and GM; and cloud chamber. These items are used to demonstrate concepts relating to the information contained in the slide presentation.

58 GEOSCIENCES

5801 Geology And Hydrology

43987 **Eruptive style and location of volcanic centers in the Miocene Washington Cascade Range: reconstruction from the sedimentary record.** Smith, G.A.; Campbell, N.P.; Deacon, M.W.; Shafiqullah, M. (Univ. of New Mexico, Albuquerque (USA)). *Geology;* **16**: No. 4, 337-340(Apr 1988).

Primary and reworked pyroclastic material in the Ellensburg Formation of central Washington records middle and late Miocene volcanism in the Cascade Range despite the absence of correlative volcanics within the volcanic chain. Volcanics marking sources for Ellensburg detritus were eroded during the late Neogene uplift. Facies patterns and paleocurrent data suggest that the bulk of the volcaniclastics were derived from a source near Bumping Lake; a K-Ar date for an intrusion in this area supports this conclusion. Depositional patterns and characteristics of the detritus allow hypothetical reconstruction of the style of volcanism during this period. Eruptive episodes began with modest-sized Plinian eruptions followed by extended periods of dome growth. Aggradation in adjacent sedimentary basins occurred principally in response to introduction of large volumes of lithic pyroclastic material during eruptive episodes. 29 references.

5802 Geophysics

43988 **(LBL—25310) Seismic visibility of fractures.** Pyrak-Nolte, L.J.; Myer, L.R.; Cook, N.G.W. (Lawrence Berkeley Lab., CA (USA)). May 1987. Contract AC03-76SF00098. 12p. (CONF-870625—21). NTIS, PC A 03; 3; GPO Dep. Order Number DE88012023/JAW.

From 28. U.S. symposium on rock mechanics; Tucson, AZ, USA (29 Jun 1987).

Laboratory measurements of seismic travel times of compressional waves, propagated through both intact and naturally fractured specimens of quartz monzonite, were used to determine velocities of propagation. Velocities calculated from a quasi-static model were found to be too low compared to the measured velocities. A theoretical velocity is derived, based on the displacement discontinunity model of wave propagation across a fracture, which depends on the dynamic stiffness of the fracture and on frequency. Comparisons of the measured velocities and those computed from the theory agreed, and confirm the appropriatness of the displacement discontinuity model to simulate wave propagation across the fracture. From this model, changes in group time delay and signal amplitude occur at the fracture and are not distributed throughout the rock. These effects are a function of frequency and the stiffness of the fracture. This suggests that the use of seismic tomographic techniques would yield both the location and mechanical properties of discrete fractures.

43989 **(SLAC-PUB—4474) Integrated database approach for geodetic applications.** Ruland, R.; Ruland, D. (Stanford Linear Accelerator Center, Menlo Park, CA (USA); Wuerzburg Univ. (Germany, F.R.). Dept. of Computer Science). Nov 1987. Contract AC03-76SF00515. 20p. (CONF-8806166—2). NTIS, PC A03/MF A01; 1; GPO Dep. Order Number DE88012726/JAW.

From 4. international working conference on statistical and scientific database management; Rome, Italy (21 Jun 1988).

Geodetic measurements even of a defined project produce a vast amount of heterogeneous data. The analysis of these data used to be time-and-manpower consuming and only focused on subsets of the data. This paper demonstrates how an integrated database system will provide an immediate standardized and easy access to the entire information support data management, and, consequently, streamline the analysis. 17 refs., 12 figs., 6 tabs.

43990 **Physical model for earthquakes, 1. Fluctuations and interactions.** Rundle, J.B. (Sandia National Laboratories, Albuquerque, New Mexico). *Journal of Geophysical Research;* **93**: No. B6, 6237-6254(10 Jun 1988).

This is the first of a series of papers whose purpose is to develop the apparatus needed to understand the problem of earthquake occurrence in a more physical context than has often been the case. To begin, it is necessary to introduce the idea that earthquakes represent a fluctuation about the long-term motion of the plates. This idea is made mathematically explicit by the introduction of a concept called the fluctuation hypothesis. Under this hypothesis, all physical quantities which pertain to the occurrence of earthquakes are required to depend on a physically meaningful quantity called the offset phase, the difference between the present state of slip on the fault and its long-term average. For the mathematical treatment of the fluctuation problem it is most convenient to introduce a spatial averaging, or "coarse-graining" operation, dividing the fault plane into a lattice of N patches. In this way, integrals are replaced by sums, and differential equations are replaced by algebraic equations. As a result of these operations the physics of earthquake occurrence can be stated in terms of a physically meaningful energy functional: an "external potential" W/sub E/. W/sub E/ is a functional potential for the stress on the fault plane acting from the external medium and characterizes the energy contained within the medium external to the fault plane which is available to produce earthquakes. A simple example is discussed which involves the dynamics of a one-dimensional fault model. To gain some understanding, a simple friction law and a failure algorithm are assumed. It is shown that under certain circumstances the model fault dynamics undergo a sudden transition from a spatially ordered, temporally disordered state to a spatially disordered, temporally ordered state.

43991 **Physical model for earthquakes, 2. Application to southern California.** Rundle, J.B. (Sandia National Laboratories, Albuquerque, New Mexico). *Journal of Geophysical Research;* **93**: No. B6, 6255-6274(10 Jun 1988).

The purpose of this paper is to apply ideas developed in a previous paper to the construction of a detailed model for earthquake dynamics in southern California. The basis upon which the approach is formulated is that earthquakes are perturbations on, or more specifically fluctuations about, the long-term motions of the plates. This concept is made mathematically precise by means of a "fluctuation hypothesis," which states that all physical quantities as-

sociated with earthquakes can be expressed as integral expansions in a fluctuating quantity called the "offset phase." While in general, the frictional stick-slip properties of the complex, interacting faults should properly come out of the underlying physics, a simplification is made here, and a simple, spatially varying friction law is assumed. Together with the complex geometry of the major active faults, an assumed, spatially varying Earth rheology, the average rates of long-term offsets on all the major faults, and the friction coefficients, one can generate synthetic earthquake histories for comparison to the real data.

43992 **Neogene rhyolites of the northern Jemez volcanic field, New Mexico.** Loeffler, B.M.; Vaniman, D.T.; Baldridge, W.S.; Shafiqullah, M. (Department of Geology, Colorado College, Colorado Springs). *Journal of Geophysical Research;* **93**: No. B6, 6157-6167(10 Jun 1988).

Volcanic centers previously mapped as the 20 Ma El Rechuelos Rhyolite in the northern Jemez volcanic field, New Mexico, include three distinct episodes of rhyolitic volcanism. An early (7.5 Ma) extrusive dome of flow-banded biotite rhyolite and an intermediate (5.8 Ma) rhyolite, possibly a volcanic neck, correspond in age to rhyolites of the Keres Group in the southern Jemez volcanic field. Three other extrusive domes of aphyric, pumiceous rhyolite and obsidian comprise a late volcanic episode, dated at 2.0 Ma. We retain the name El Rechuelos Rhyolite only for these late centers. Another center, farther north than the others but previously mapped with the El Rechuelos Rhyolite, is a dacite pumice ring whose age (5.2 Ma), petrography, major- and trace-element chemistry, and Sr initial ratio all suggest it should be included with rocks of the Tschicoma Formation. Nd and Sr isotopic ratios of the Neogene rhyolites of the northern Jemez volcanic field suggest that these rhyolites were not produced by partial melting of either upper or lower crust. Rather, they may have been generated from a mantle-derived mafic magma, such as the nearby Lobato Basalt, by fractional crystallization with concomitant assimilation of small amounts (<6%) of lower crust. If the El Rechuelos is derived from a lower crust magma chamber, as seems likely, then it is not related to the bandelier magma system, even though it is part of a continuum of rhyolite volcanism ranging from 3.6 Ma to 130,000 years ago that includes the Bandelier and precursor rhyolitic units. copyright American Geophysical Union 1988

43993 **Degassing of rhyolitic magma during ascent and emplacement.** Westrich, H.R.; Stockman, H.W.; Eichelberger, J. (Geochemistry Division, Sandia National Laboratories, Albuquerque, New Mexico). *Journal of Geophysical Research;* **93**: No. B6, 6503-6511(10 Jun 1988).

The degassing history of a rhyolitic igneous system was documented from analyses of drill core samples through the extrusive and intrusive portions of Obsidian Dome and of surface samples of associated tephra. The initial volatile composition of the Inyo magma was estimated to be 4.0 wt % H_2O, 500 ppm F, 800 ppm Cl, and 80 ppm S. Retained volatile contents of glassy and crystalline samples reflect the effects of decompression and second boiling. Decompression is rapid and involves loss of water-rich fluid until a close approach to lithostatic equilibrium is achieved. Second boiling is a slower process and produces a chlorine-rich fluid, some of which can be trapped during development of extremely fine crystallization textures. Nearly complete dewatering during decompression of surface-extruded magma strongly undercools the system ($\Delta T \cong 175$ °C), suppressing crystallization and yielding glassy rhyolitic lava. Partial degassing of shallowly intruded magma permits pervasive crystallization even at high cooling rates. The subvolcanic intrusive regime is the zone of maximum volatile release because second boiling is incomplete in extrusives, and volatile-bearing crystalline phases are stable in magma crystallized at greater depth. copyright Amierican Geophysical Union 1988

43994 **Crustal structure in eastern Kazakh, U.S.S.R. from teleseismic receiver functions.** Priestley, K.F.; Zandt, G.; Randall, G.E. (Seismological Laboratory, University of Nevada at Reno, Reno, NV). *Geophysical Research Letters;* **15**: No. 6, 613-616(Jun 1988).

Broadband receiver functions determined from teleseismic P-waveforms recorded at two seismic stations in eastern Kazakh, U.S.S.R., are inverted for the vertical velocity structure beneath the stations. The detailed broadband receiver functions are obtained by stacking source-equalized radial components of teleseismic P-waveforms. A time-domain inversion of the radial receiver function is used to determine the structure assuming a crustal model parameterized by flat-lying, homogeneous layers. The general features of the inversion results are: a complex shallow crust, velocities less than 6 km/s in the upper curst, a high velocity (6.9—7.5 km/s) lower crust, and a Moho that varies between 47 and 57 km depth. These results compare favorably with a composite velocity model from Deep Seismic Sounding data, but show lower velocities in the upper curst, and higher velocities in the lower crust. The results indicate that the crust in this region is relatively uniform, however the nature and depth of the Moho changes significantly across the region. The receiver function inversion structure for the Kazakh sites is similar to a published receiver function structure for a site on the Canadian Shield. copyright American Geophysical Union 1988

43995 **Fracture fillings and intrusive pyroclasts, Inyo Domes, California.** Heiken, G.; Wohletz, K.; Eichelberger, J. (Earth and Space Science Division, Los Alamos National Laboratory, Los Alamos, New Mexico). *Journal of Geophysical Research;* **93**: No. B5, 4335-4350(10 May 1988).

Fractures containing juvenile magmatic pyroclasts were encountered during drilling into a 600-year-old feeder dike beneath the Inyo Domes chain, California. The Inyo Domes consist of a north-south trending, 10-km-long chain of domes, rhyolitic tuff rings, and phreatic craters. Boreholes were cored through the 51-m-diameter conduit of Obsidian Dome, the largest of the Inyo Domes, and through an unvented portion of the intrusion (dike) 1 km to the south. Pyroclast-bearing fractures were intersected in both holes: (1) 7- to 40-cm-thick fractures in welded basaltic scoria and quartz monzonite country rock are adjacent to the conduit at depths of 400—411 m and 492—533 m; they contain gray, clastic deposits, which show truncated cross bedding and convolute bedding; (2) adjacent to the dike, massive fracture fillings occur at depths of 289—302 m (129 m east of the dike) and 366—384 m (95—87 m east of the dike).

43996 **Temporal change in coda wave attenuation observed during an eruption of Mount St. Helens.** Fehler, M.; Roberts, P.; Fairbanks, T. (Los Alamos National Laboratory, New Mexico). *Journal of Geophysical Research;* **93**: No. B5, 4367-4373(10 May 1988).

During the past few years there have been numerous reports of changes in coda wave attenuation occurring before major earthquakes. These observations are important because they may provide insight into stress-related structural changes taking place in the focal region prior to the occurrence of large earthquakes. The results of these studies led us to suspect that temporal changes in coda wave attenuation might also accompany volcanic eruptions. By measuring power decay envelopes for earthquakes at Mount St. Helens recorded before, during, and after an eruption that took place during September 3—6, 1981, we found that coda Q^{-1} for frequencies between 6 and 30 Hz was 20—30% higher before the eruption than after. The change is attributed to an increase in the density of open microcracks in the rock associated with inflation of the volcano prior to the eruption. Q^{-1} was found to be only weakly dependent on frequency and displayed a slight peak near 10 Hz. The weak frequency dependence is attributed to the dominance of intrinsic attenuation over scattering attenuation, since it is generally accepted that intrinsic attenuation is constant with frequency, whereas scattering attenuation decreases strongly at higher frequencies. The weak frequency dependence of Q^{-1} at Mount St. Helens contrasts with results reported for studies in nonvolcanic regions. The peak in Q^{-1} near 10 Hz at Mount St. Helens is attributed to the scale length of heterogeneity responsible for generating backscattered waves. Results for nonvolcanic regions have shown this peak to occur near 0.5 Hz. Thus a smaller scale length of heterogeneity is required to explain the 10-Hz peak at Mount St. Helens. copyright American Geophysical Union 1988

43997 Direct rate measurements of eruption plumes at Augustine volcano: A problem of scaling and uncontrolled variables. Rose, W.I.; Heiken, G.; Wohletz, K.; Eppler, D.; Barr, S.; Miller, T.; Chuan, R.L.; Symonds, R.B. (Michigan Technological University, Houghton). *Journal of Geophysical Research;* **93**: No. B5, 4485-4499(10 May 1988).

The March—April 1986 eruption of Augustine Volcano, Alaska, provided an opportunity to directly measure the flux of gas, aerosol, and ash particles during explosive eruption. Most previous direct measurements of volcanic emission rates are on plumes from fuming volcanoes or on very small eruption clouds. Direct measurements during explosive activity are needed to understand the scale relationships between passive degassing or small eruption plumes and highly explosive events. Conditions on April 3, 1986 were ideal: high winds, clear visibility, moderate activity. Three measurements were made: (1) an airborne correlation spectrometer (Cospec) provided mass flux rates of SO_2; (2) treated filter samples chemically characteized the plume and (3) a quartz crystal microcascade impactor provided particle size distribution. Atmospheric conditions on April 3 caused the development of a lee wave plume, which allowed us to constrain a model of plume dispersion leading to a forecast map of concentrations of SO_2 at greater distances from the vent.

5803 Mineralogy, Petrology, And Rock Mechanics

43998 (CRIE-U—87010) Survey of the characteristics of rock under low and high temperature. Shin, Koichi; Kitano, Koichi. (Central Research Inst. of Electric Power Industry, Tokyo (Japan)). Jul 1987. 34p. (In Japanese). Central Research Inst. of Electric Power Industry, 1-6-1, Otemachi, Chiyoda-ku, Tokyo.

Rock caverns for Super-conducting Magnetic Energy Storage or Liquefied Natural Gas Storage will suffer extraordinary temperature. Therefore, authors have researched the rock characteristics under the low temperature conditions and the rock mass behavior when it is heated, by papers so far reported. As a result, rock characteristics such as strength, linear expansion coefficient, thermal conductivity etc. are found to be ready to change with temperature condition and the kind of rocks. Even an anisotropy of some kind appears under some conditions. So, when sitting those facilities before mentioned, rock characteristics under each temperature condition must be enough clarified for the purpose of the evaluation of rock cavern stability and especially, rock behavior when it is loaded dynamically under low temperature must be cleared from now on, for such studies have been few. Items of the report are: Rocks under low temperature, rocks subjected to freezing and melting, and thermal impact, basic properties of rocks under high temperature, and thermal experiment at Stripa and Climax Mines. (47 figs, 2 tabs, 49 refs)

43999 Postshock temperatures in silica. Boslough, M.B. (Sandia National Laboratories, Albuquerque, New Mexico). *Journal of Geophysical Research;* **93**: No. B6, 6477-6484(10 Jun 1988).

Experimental postshock temperatures for crystalline quartz released from shock states between 86 and 127 GPa and for fuset silica released from 59 to 73 GPa have been determined using previously measured spectral radiance data. The temperatures range from 3660 to 4150 K and are consistent with the interpretation based on shock temperature measurements, that the Hugoniot of SiO_2 crosses the phase boundary between stishovite and liquid. The new postshock temperatures were used to determine the Grueneisen parameter of liquid silica at high pressures and temperatures and the specific volume of the release state ($\gamma/V = 3.5$ Mg/m^3 and F/sub r/ = 0.266 m^3/Mg, respectively), although there is some ambiguity as to whether this volume corresponds to a partial or total release state. To show the validity of these postshock temperatures, a radiative transport model was extended to times after free surface arrival of the shock wave. copyright American Geophysical Union 1988

44000 Rheology of subliquidus magmas. 1. Picritic composition. Ryerson, F.J.; Weed, H.C.; Piwinskii, A.J. (Lawrence Livermore National Laboratory, Livermore, California). *Journal of Geophysical Research;* **93**: No. B4, 3421-3436(10 Apr 1988).

The relationship between the rheology and phase equilibria of a picritic basalt from Kilauea Iki has been investigated at 1 atm along the QFM buffer. Between 1270° and 1180 °C olivine and minor spinel are the only liquidus phases, and the melt volume decreases from 85 to 74 vol %. At the ol-sp-pc-cpx cotectic, melt is consumed more rapidly dropping to 47 vol % at 1139 °C. The rheology of the magma is non-Newtonian, is characterized by time-dependent, pseudoplastic behavior, and is consistent with power law flow or Bingham pseudoplastic behavior. Non-newtonian effects are most apparent when the crystal volume is greater than 25% and the shear rate is increasing. Once stirred, the magma approaches Newtonian rheology with decreasing shear rate. At 1170 °C (approximately 25% suspended crystals) the apparent activation energy (calculated at unit shear rate) increases from 123 +- 10 kcal mol^{-1} to 452 +- 21 kcal mol^{-1}. When the change in liquid composition along the liquidus is included, the observed viscosities are in good agreement with those calculated from the Einstein-Roscoe equation for a serial size distribution of crystals. A quadratic fit to the shear stress-strain rate data yields a nonzero intercept indicative of a finite yield strength. The apparent yield strength increases with decreasing temperature reaching ≈800 Pa at 1149 °C. These extrapolated (and model dependent) values are in good agreement with those determined by other methods (Shaw et al., 1968; McBirney and Murase, 1984).

5804 Geochemistry

REFER ALSO TO CITATION(S) 42706

44001 Titanium isotopic anomalies in chondrules from carbonaceous chondrites. Niemeyer, S. (Lawrence Livermore National Lab., CA (USA)). *Geochimica et Cosmochimica Acta;* **52**: No. 2, 309-318(Feb 1988). Contract W-7405-ENG-48.

Isotopic analyses of Ti from chondrules of carbonaceous chondrites reveal that Ti anomalies are present; anomalies are detected only at ^{50}Ti. For a suite of eight Allende chondrules, four give well-resolved anomalies which range from a ^{50}Ti deficit of two epsilon-units to a ^{50}Ti excess of nine epsilon-units. No clear link is evident between the structure or composition of the chondrules and the Ti anomalies. However, the chondrule with by far the largest Ti isotopic anomaly is also Al-rich. Yet the absence of a strict correlation between the Ca, Al, & Ti contents and the Ti anomalies, together with the similarity of the ^{50}Ti excess for the one chondrule to that of most Ca-Al-rich inclusions (CAIs), indicate that the relation between degree of refractory enrichment and the magnitude of Ti isotopic anomalies is not a simple one. Single chondrules from Murchison, Kaidun, and Kakangari all fail to exhibit a well-resolved anomaly, although in the latter two the single analysis of each precludes resolving anomalies of less than three epsilon-units. These observations support the view that the Ti isotopic diversity in chondrules in an inherited feature from their precursor assemblages of dust. Models which envision similar precursors for both chondrules and matrix are consistent with the Ti isotopic data. But at least two distinct solid-matter reservoirs are required for the Allende chondrules alone, which underscores the diversity in the nebular dust. These Ti anomalies also caution that more than one dust isotopic component may be necessary to account fully for the oxygen isotopic variations in chondrules. The Ti anomalies in chondrules argue strongly against models which ascribe the Ti anomalies in CAIs to unique features of their evolution; instead, heterogeneities were more common in the nebular dust.

44002 Diffusive motion in alkali silicate melts: an NMR study at high temperature. Liu, S.B.; Stebbins, J.F.; Schneider, E.; Pines, A. (Stanford Univ., CA (USA)). *Geochimica et Cosmochimica Acta;* **52**: No. 2, 527-538(Feb 1988). Contract AC03-76SF00098.

Nuclear magnetic resonance (NMR) spectroscopy at high temperature is an excellent tool for studying the atomic scale diffu-

sive processes in molten silicates which control their transport and thermodynamic properties. The authors present here ^{23}Na and ^{29}Si NMR data on lineshapes, spin-lattice, and spin-spin relaxation times in a series of alkali silicate and aluminosilicate melts from room temperature to about 1200°C. ^{29}Si lineshapes show that exchange of oxygens between bridging and non-bridging sites takes place at the microsecond-to nanosecond time scale at liquidus temperatures, making the lifetimes of silicate molecules very short. This process is probably a fundamental step in viscous flow and configurational entropy generation. ^{23}Na relaxation time data suggest that the motion that causes relaxation is closely related to that of through-going diffusion, and the mixed-alkali effect is detectable in activation energies. The mechanism for ^{29}Si spin-lattice relaxation changes at or near the glass transition, showing a close link between local diffusive motion and bulk thermodynamic properties.

64 PHYSICS I

6401 Astrophysics And Cosmology

REFER ALSO TO CITATION(S) 43529, 43786, 44026, 44082, 44344, 44346

44003 **(JINR-R—2-87-819) On a solution of the Einstein gravitation equation for dust matter.** Bonch-Osmolovskij, A.G. (Joint Inst. for Nuclear Research, Dubna (USSR). Lab. of High Energy). 1987. 11p. (In Russian). NTIS (US Sales Only), PC A03/MF A01. Order Number DE88703739/JAW.

Submitted to the journal Zh. Ehksp. Teor. Fiz. .

Exact analytical solution for the Einstein equations for dust has been obtained and investigated. The main results are as follows: the model described homogeneous and isotopic Universe which expands without restriction at $\Lambda > 0$ and oscillates at $\Lambda < 0$; evaluation for negative Λ and Universe's iscillations period is chemical bondΛ? ~ 10/sup -56/ cm/sup -2/, T ~ 3x10/sup 10/ years; near singularities the density of matter changes according to the universal law: rho ~ (r-r/sub c/)/sup -2/, r/sub c/ is the proper time momentum corresponding to the singularity. Possible consequences of this fact are discussed. 6 refs.; 2 figs.

44004 (KEK—87-20, pp 177-179) **Possible neutrino oscillation in the observed neutrino burst from SN1987a.** Midorikawa, S.; Terazawa, H.; Akama, K. (Tokyo Univ., Tanashi (Japan). Inst. for Nuclear Study). Nov 1987. NTIS (US Sales Only), PC A12/MF A01. Order Number DE88780084/JAW. (CONF-8705290—).

From Meeting on physics at TeV energy scale; Oho, Japan (28 May 1987).

Possible periodic structure has been found in the observed spectrum of inverse electron neutrino energies of the KAMIOKANDE-II and IMB data on the neutrino burst from the supernova SN1987a. By comparing the data with our model calculations, the mass squared difference of neutrinos is estimated.

44005 **(RRK—88-2) Clustering of galaxies and clusters of galaxies in a decaying-particle cosmological model with a massive decay product.** Tomita, Kenji. (Hiroshima Univ., Takehara (Japan). Research Inst. for Theoretical Physics). Jan 1988. 46p. NTIS (US Sales Only), PC A03/MF A01. Order Number DE88753434/JAW.

Based on a decaying-particle cosmological model with a massive decay product whose present Jeans wavelength is ~ 30 h^{-1}Mpc (the Hubble constant $H_0 = 100$ h km $s^{-1}Mpc^{-1}$), we study the correlation functions and velocity distributions of galaxies and clusters of galaxies using the direct method of N body simulation for these objects and the simple difference method for the dark matter fluid consisting of the decay product. It is assumed that the index N/sub s/ of the initial density perturbations is 0, -1 and -2, the redshift z/sub d/ corresponding to the decay time is 2 ~ 3 and the present density parameter Ω/sub d0/ for the decay product is 0.8 ~ 0.9. The dark matter fluid prevents galaxies from clustering in the small-scale and helps clusters of galaxies clustering in the large-scale. Owing to this role of the dark matter fluid, models in the case N/sub s/ = 0 ~ -1, zeta$_0$ = 0.8 ~ 0.9 and z/sub d/ = 2.0 ~ 3.0 are found to be consistent with the observational results on the correlation functions and velocity distributions.

44006 **Experimental limit on the flux of relic antineutrinos from past supernovae.** Zhang, W.; Beier, E.W.; Feldscher, L.; Frank, E.D.; Frati, W.; Kim, S.B.; Mann, A.K.; Newcomer, F.M.; Van Berg, R.; Hirata, K.S.; and others. (Department of Physics, University of Pennsylvania, Philadelphia, Pennsylvania 19104). *Physical Review Letters;* **61**: No. 4, 385-388(25 Jul 1988).

We report the result of a search in the Kamiokande II detector for the interactions of electron-type antineutrinos in the energy interval 19 to 35 MeV. We measure directly a 90%-confidence-level upper limit of 226 cm/sup -2/ sec/sup -1/ on the flux of electron antineutrinos with energies in that interval. An upper limit on the total flux of relic antineutrinos from past supernovae is obtained as a function of the effective equilibrium temperature of the relic antineutrino sea.

44007 **Observation in the Kamiokande-II detector of the neutrino burst from supernova SN1987A.** Hirata, K.S.; Kajita, T.; Koshiba, M.; Nakahata, M.; Oyama, Y.; Sato, N.; Suzuki, A.; Takita, M.; Totsuka, Y.; Kifune, T.; and others. (International Center for Elementary Particle Physics, University of Tokyo, Tokyo 113, Japan). *Physical Review [Section] D: Particles and Fields;* **38**: No. 2, 448-458(15 Jul 1988).

The properties of the Kamiokande-II detector and the method of measurement are described in detail. The data on the neutrino burst from the supernova SN1987A on 23 February 1987 at 7:35:35 UT +- 1 min are presented, with records of earlier and later observation periods in which other neutrino events possibly associated with SN1987A might have occurred. There is no evidence in the data for any excess of neutrino-induced events, either in a burst of a few seconds duration or over a longer time interval, relative to the usual count rate, excepting only the neutrino burst at 7:35:35 UT. The nature of the single, observed neutrino burst coincides remarkably well with the elements of the current model of type-II supernovae and neutron-star formation. This is the first direct observation in neutrino astronomy.

44008 **New limit on the low-energy antiproton/proton ratio in the Galactic cosmic radiation.** Ahlen, S.P.; Barwick, S.; Beatty, J.J.; Bower, C.R.; Gerbier, G.; Heinz, R.M.; Lowder, D.; McKee, S.; Mufson, S.; Musser, J.A.; and others. (Physics Department, Boston University, Boston, Massachusetts 02215). *Physical Review Letters;* **61**: No. 2, 145-148(11 Jul 1988).

We describe the results of a balloon-borne apparatus searching for low-energy antiprotons in the Galactic cosmic rays. For energies less than 640 MeV at the top of the atmosphere, no cosmic-ray antiprotons were observed. This yields an upper limit to the p-bar/p ratio of 4.6 x 10/sup -5/ at the 85% confidence level.

44009 **Angular distribution of events from SN1987A.** Bratton, C.B.; Casper, D.; Ciocio, A.; Claus, R.; Crouch, M.; Dye, S.T.; Errede, S.; Gajewski, W.; Goldhaber, M.; Haines, T.J.; and others. (The University of California, Irvine, California 92717 The University of Michigan, Ann Arbor, Michigan 48109 Brookhaven National Laboratory, Upton, New York 11973 Cleveland State University, Cleveland, Ohio 44115 The University of Hawaii, Honolulu, Hawaii 96822 University College, London WC1E 6BT, United). *Physical Review [Section] D: Particles and Fields;* **37**: No. 12, 3361-3363(15 Jun 1988).

The energy and trigger response of the Irvine-Michigan-Brookhaven detector at the time of supernova SN1987A has been studied further since the detection of a burst of neutrinos on 23 February 1987. Here we present improved measurements of the event energies and energy uncertainties, relative times, triggering efficiencies, and angles from the presumed source. The detector is found to have no significant directional bias against tracks moving in the direction toward the supernova. The statistical significance of the observed excess of events pointing away from the Large Magellanic Cloud is discussed.

44010 **Signal modulation in cold-dark-matter detection.** Freese, K.; Frieman, J.; Gould, A. (Institute for Theoretical Physics, University of California, Santa Barbara, California 93106). *Physical Review* [*Section*] *D: Particles and Fields;* 37: No. 12, 3388-3405(15 Jun 1988).

If weakly interacting massive particles (WIMP's) are the dark matter in the galactic halo, they may be detected in low-background ionization detectors now operating or with low-temperature devices under development. In detecting WIMP's of low mass or WIMP's with spin-dependent nuclear interactions (e.g., photinos), a principal technical difficulty appears to be achieving very low thresholds (approx. < keV) in large (~ kg) detectors with low background noise. We present an analytic treatment of WIMP detection and show that the seasonal modulation of the signal can be used to detect WIMP's even at low-signal-to-background levels and thus without the necessity of going to very-low-energy thresholds. As a result, the prospects for detecting a variety of cold-dark-matter candidates may be closer at hand than previously thought. We discuss in detail the detector characteristics required for a number of WIMP candidates, and carefully work out expected event rates for several present and proposed detectors.

44011 **Friedel oscillations in relativistic QED and QCD.** Kapusta, J.; Toimela, T. (School of Physics and Astronomy, University of Minnesota, Minneapolis, Minnesota 55455). *Physical Review* [*Section*] *D: Particles and Fields;* 37: No. 12, 3731-3736(15 Jun 1988).

Modification of Debye screening and Friedel-type oscillations are found in high-density QED and QCD. At distances r>>1/m/sub el/ and in the ultrarelativistic limit the screened potential of two charges behaves like $\sim\alpha^2\sin(2k/\text{sub F}/r)/r^4$. This may have implications for charmonium suppression in the fragmentation region in ultrarelativistic heavy-ion collisions and for the screening of impurities in white-dwarf stars.

44012 **Matter oscillations: Neutrino transformation in the Sun and regeneration in the Earth.** Baltz, A.J.; Weneser, J. (Physics Department, Brookhaven National Laboratory, Upton, New York 11973). *Physical Review* [*Section*] *D: Particles and Fields;* 37: No. 12, 3364-3377(15 Jun 1988).

Calculations of neutrino regeneration phenomena in the Earth as well as transformation in the Sun are presented with relevant predictions for several existing and planned neutrino detection experiments. The validity of computational approximations in the solar case is appropriately investigated. Sensitivity of the calculated results to the solar model is noted. Transformation and regeneration phenomena are calculated to result from transmission through the Earth of neutrinos with $E(\text{MeV})/\Delta m^2(\text{eV}^2)$ in the vicinity of 10^6 to 10^7. As a result, large time-of-night and seasonal variations are predicted for various solar-neutrino experiments in this parameter range. Analogous effects are predicted for terrestrial cosmic-ray and accelerator experiments.

44013 **Cosmological consequences of a rolling homogeneous scalar field.** Ratra, B.; Peebles, P.J.E. (Joseph Henry Laboratories, Department of Physics, Princeton University, Princeton, New Jersey 08544). *Physical Review* [*Section*] *D: Particles and Fields;* 37: No. 12, 3406-3427(15 Jun 1988).

The cosmological consequences of a pervasive, rolling, self-interacting, homogeneous scalar field are investigated. A number of models in which the energy density of the scalar field red-shifts in a specific manner are studied. In these models the current epoch is chosen to be scalar-field dominated to agree with dynamical estimates of the density parameter, Ω/sub dyn/~0.2, and zero spatial curvature. The required scalar-field potential is "nonlinear" and decreases in magnitude as the value of the scalar field increases. A special solution of the field equations which is an attractive, time-dependent, fixed point is presented. These models are consistent with the classical tests of gravitation theory. The Eoetvoes-Dicke measurements strongly constrain the coupling of the scalar field to light (nongravitational) fields. Nucleosynthesis proceeds as in the standard hot big-bang model. In linear perturbation theory the behavior of baryonic perturbations, in the baryon-dominated epoch, do not differ significantly from the canonical scenario, while the presence of a substantial amount of homogeneous scalar-field energy density at low red-shifts inhibits the growth of perturbations in the baryonic fluid. The energy density in the scalar field is not appreciably perturbed by nonrelativistic gravitational fields, either in the radiation-dominated, matter-dominated, or scalar-field-dominated epochs. On the basis of this effect, we argue that these models could reconcile the low dynamical estimates of the mean mass density with the negligibly small spatial curvature preferred by inflation.

44014 **Gravitational production of scalar particles in inflationary-universe models.** Turner, M.S.; Widrow, L.M. (NASA/Fermilab Astrophysics Center, Fermi National Accelerator Laboratory, Batavia, Illinois 60510). *Physical Review* [*Section*] *D: Particles and Fields;* 37: No. 12, 3428-3437(15 Jun 1988).

We study the production of massive scalar particles (with $m<H_0$) in inflationary-universe models. A given mode of the scalar field is quantum mechanically excited when it is well within the Hubble radius (equivalentH_0/sup -1/) during the de Sitter phase of inflation. It then crosses outside the Hubble radius after which it is treated classically. Ultimately, long after reentering the Hubble radius, the fluctuations correspond to nonrelativistic scalar particles. The energy density in these particles depends on the Hubble parameter during inflation, the mass of the particle species, and the coupling of the scalar field to the curvature scalar. The energy density may contribute significantly to the total energy density in the Universe; in addition, new constraints to the value of the Hubble constant during inflation follow. As an example we apply our results to axions.

44015 **Primordial nucleosynthesis: The effects of injecting hadrons.** Reno, M.H.; Seckel, D. (Fermi National Accelerator Laboratory, P.O. Box 500, Batavia, Illinois 60510). *Physical Review* [*Section*] *D: Particles and Fields;* 37: No. 12, 3441-3462(15 Jun 1988).

We place constraints on the abundance of quasistable particles with hadronic decay modes using the upper bounds on primordially produced ^{4}He and the sum of D and ^{3}He abundances. The results are presented as a function of particle lifetime (ranging between 10/sup -1/ and 10^4 sec), particle mass, and hadronic branching ratio. We apply our results to the cases of gravitinos, photinos in R-italic-tilde-parity-violating theories, and mirror quarks. We also discuss another mechanism for hadron injection: cold-dark-matter annihilation.

44016 **Martian neutron leakage spectra.** Drake, D.M.; Feldman, W.C.; Jakosky, B.M. (Los Alamos National Laboratory, Los Alamos, New Mexico). *Journal of Geophysical Research;* 93: No. B6, 6353-6368(10 Jun 1988).

Energy spectra of Martian leakage neutrons are calculated by a high-energy nucleon-meson transport code using a Monte Carlo technique and a one-dimensional diffusion accelerated neutral-particle transport code, which solves the Boltzmann equation. Four series of calculations were made to simulate (1) a uniform surface layer containing various amounts of H_2O, (2) different burial depths of a 50% H_2O layer underneath a 1% H_2O layer, (3) changing atmospheric pressure, and (4) a thick CO_2 ice sheet overlying a "dirty" water ice sheet. We found that all calculated spectra at energies less than about 1000 eV could be fitted by a superposition of thermal and epithermal functions having four free parameters. Two of these parameters, the thermal and epithermal amplitudes, were found to vary systematically over ranges exceeding 1 order of magnitude and to specify uniquely the configuration in each of the series. We conclude that measurements of leakage neutron spectra should allow determination of the hydrogen content of surface layers buried to depths up to about 100 g/cm^2 and determination of the thickness of a polar dry ice cap up to thicknesses of about 250 g/cm^2. Variations of these parameters were also shown to depend on the composition of the assumed surface layers through the average atomic mass and the macroscopic scattering and absorption cross sections. copyright American Geophysical Union 1988

6402 Atmospheric Physics

44017 (JINR-R—2-87-504) Modelling of central density spectra of extensive air showers from primary particles with E=10/sup 2/-10/sup 7/ GeV. Arkhestov, G.Kh.; Beshtoev, Kh.M. (Joint Inst. for Nuclear Research, Dubna (USSR). Lab. of Computing Techniques and Automation; AN SSSR, Moscow. Inst. Yadernykh Issledovanij). (Joint Inst. for Nuclear Research, Dubna (USSR). Lab. of Computing Techniques and Automation). 1987. 8p. (In Russian). NTIS (US Sales Only), PC A02/MF A01. Order Number DE88703728/JAW.

Calculations are made for the distributions of central densities of extensive air showers (of elctromagnetic particles) by integrating over radii R≥0.4 m and R≥0.8 m and the spectrum over the total number of particles in a shower of primary incident particles with E=10/sup 2/-10/sup 7/ GeV. Comparison with experiment is presented. 13 refs.; 2 figs.

44018 Observations of ionospheric cavities generated by high-power radio waves. Duncan, L.M.; Sheerin, J.P.; Behnke, R.A. (Los Alamos National Laboratory, Los Alamos, New Mexico 87545). *Physical Review Letters;* **61**: No. 2, 239-242(11 Jul 1988).

High-power hf electromagnetic waves have been used to generate large electron-density cavities in the night-time F-region ionospheric plasma. Previous modification experiments have described induced density perturbations of only a few percent. Here we report the first observations of density depletions exceeding 50%, extending hundreds of kilometers along the geomagnetic field. These cavities are thermally driven, with electron temperatures in the depletions increased by factors of 3 to 4. The depletion dynamics exhibits many of the characteristics associated with thermal cavitons.

6403 Atomic, Molecular, And Chemical Physics

REFER ALSO TO CITATION(S) 44278

44019 (ATOMKI-B—20(1987)) On the velocity dependence and shape of the double differential cross section in the charge exchange to the continuum processes. Jakab, L. (Magyar Tudomanyos Akademia, Debrecen. Atommag Kutato Intezete). 1987. 4p. NTIS (US Sales Only), PC A02/MF A01. Order Number DE88701717/JAW.

An expansion formula for the double differential cross section in terms of Bernouilli constants is presented. Person's definition of skewness is recalled to express the asymmetry of a distribution curve by using its second, third and fourth moments.

44020 (CONF-880435—3) The structure of the stable negative ion of calcium. Pegg, D.J.; Thompson, J.S.; Compton, R.N.; Alton, G.D. (Tennessee Univ., Knoxville (USA); Oak Ridge National Lab., TN (USA)). 1988. Contract AC05-84OR21400. 5p. NTIS, PC A02/MF A01;1; GPO Dep. Order Number DE88008693/JAW.

From 4. international symposium on resonance ionization spectroscopy and its applications; Gaithersburg, MD, USA (10 Apr 1988).

The structure of the Ca/sup {minus/} ion has been determined using a crossed laser-ion beams apparatus. The photoelectron detachment spectrum shows that, contrary to earlier expectations, the Ca/sup {minus/} ion is stably bound in the $(4s^24p)^2p$ state. The electron affinity of Ca was measured to be 0.043 +- 0.007 eV.

44021 (DOE/DP/40200—55) Radial compression of picosecond electrical pulses. Bamber, C.; Donaldson, W.; Juhasz, T.; Kingsley, L.; Melissinos, A.C. (Rochester Univ., NY (USA). Lab. for Laser Energetics). Nov 1987. Contract FC08-85DP40200. 19p. NTIS, PC A03/MF A01;1; GPO Dep. Order Number DE88008440/JAW.

We used 1ps, 1mJ pulses from a Nd:glass laser system to produce kilovolt electrical pulses with rise time of the order of 15ps. The pulses propagated radially between two circular discs resulting in a voltage gain of 2 at the center of the discs as compared to the circumference in qualitative agreement with calculation. Such structures can be used to produce very high gradient accelerating fields. (WRF)

44022 (FNAL-TM—1305) NCenter wide band neutrino beam. Stutte, L.G. (Fermi National Accelerator Lab., Batavia, IL (USA)). 26 Mar 1985. Contract AC02-76CH03000. 27p. NTIS, PC A03/MF A01;1; GPO Dep. Order Number DE88012102/JAW.

This memo describes the physical properties of the currently operating N-Center wide band neutrino beam---commonly called the triplet train, following a past tradition of a triplet lens configuration. In reality, in order to gain a larger momentum acceptance and to minimize the angular divergence of the beam, a quadruplet beam (4 lenses) employing point-to-parallel optics at a central momentum of 300 GeV was built. 6 refs., 13 figs., 1 tab.

44023 (IAE—4486/2) Laser method of free atom nuclei orientation. Barabanov, A.L. (Gosudarstvennyj Komitet po Ispol'zovaniyu Atomnoj Ehnergii SSSR, Moscow. Inst. Atomnoj Ehnergii). 1987. 25p. (In Russian). NTIS (US Sales Only), PC A03/MF A01. Order Number DE88703508/JAW.

Orientation process of free atom (atoms in beams) nuclei, scattering quanta of circularly polarized laser radiation is considered. A method for the evaluation of nuclei orientation parameters is developed. It is shown that in the process of pumping between the ground and first excited atomic states with electron shell spins J/sub 1/ and J/sub 2/, so that J/sub 2/ = J/sub 1/ + 1, a complete orientation of nuclei can be attained. 15 refs.; 10 figs.

44024 (IAE—4507/9) Probability of collective excited state decay. Manykin, Eh.A.; Ozhovan, M.I.; Poluehktov, P.P. (Gosudarstvennyj Komitet po Ispol'zovaniyu Atomnoj Ehnergii SSSR, Moscow. Inst. Atomnoj Ehnergii). 1987. 12p. (In Russian). NTIS (US Sales Only), PC A03/MF A01. Order Number DE88703511/JAW.

Decay mechanisms of condensed excited state formed of highly excited (Rydberg) atoms are considered, i.e. stability of so-called Rydberg substance is analyzed. It is shown that Auger recombination and radiation transitions are the basic processes. The corresponding probabilities are calculated and compared. It is ascertained that the "Rydberg substance" possesses macroscopic lifetime (several seconds) and in a sense it is metastable. 9 refs.; 1 fig.

44025 (IC—88/53) Intermediate-coupling effects on the n=2 resonant photo-ionization of multiply-charged helium-like ions. Wague, A. (International Centre for Theoretical Physics, Trieste (Italy)). Mar 1988. 16p. NTIS (US Sales Only), PC A03/MF A01. Order Number DE88703532/JAW.

Diagonalization calculations of the n=2 resonant photo-ionization characteristics of multiply-charged helium-like ions C/sup 4+/, O/sup 6+/, Ne/sup 8+/, Mg/sup 10+/ and Fe/sup 24+/ are performed in the LS and intermediate-coupling approximations for a few /sup 1/P/sub 1//sup (-)/ and /sup 3/P/sub 1//sup (-)/ auto-ionization levels. The qualitative influence of relativistic effects on characteristics of resonant photo-ionization is shown. A comparison is done with perturbation calculations using the complete Breit operator. (author). 20 refs, 6 tabs.

44026 (INIS-SU—34) Collisional broadening of recombination lines in the quasi-classical region. Rovenskaya, N.I. (AN Ukrainskoj SSR, Kharkov. Radioastronomicheskij Inst.). 1987. 26p. (In Russian). NTIS (US Sales Only), PC A03/MF A01. Order Number DE88703586/JAW.

Preprint 4.

On the grounds of the quasi-classical desorption of collisional broadening of radiorecombination lines has been theoretically investigated in the case of "impact" approximation. Transition probabilities, cross sections and inelastic scattering rates were determined by analytic methods for some asymptotic states of Rydberg atoms (n>1, m/l ~ 1, m/l < 1, l/n ~ 1, l/n <1 in the energy region E/R/sub y/ < 2/n/sup 2/ for incident particles. Besides there were brought out asymptotically exact solutions for the parti-

cle energies 2/n/sup 2/ < E/R/sub y/ < 2/n. Calculated effective collision widths allow to interpret recombination lines from cold cosmic plasma components. Inelastic scattering of charged particles on the highly excited ions has been discussed supplementary.

44027 **(ITEP—177(1987)) Stark effect in intense field. 2.** Popov, V.S.; Mur, V.D.; Sergeev, A.V.; Weinberg, V.M. (Gosudarstvennyj Komitet po Ispol'zovaniyu Atomnoj Ehnergii SSSR, Moscow. Inst. Teoreticheskoj i Ehksperimental'noj Fiziki). 1987. 36p. NTIS (US Sales Only), PC A03/MF A01. Order Number DE88703622/JAW.

The problem of hydrogen atom in homogeneous electric field is considered. The Stark shifts and widths of atomic levels are computed by summation of divergent perturbation series and by 1/n-expansion - up to E values comparable with the field on the electron orbit. The results of the calculations are presented for the following sequences of states: chemical bondn/sub 1/,0,0>, chemical bond0,n/sub 2/,0>, chemical bondn/sub 1/,n/sub 1/,0>, as well as for all states with n=2 and 3 (n is the principal quantum number). The Stark shifts and widths of Rydberg states (with n=15-30) in electric field which exceeds the classical ionization threshold are computed. The results of our calculations agree with experiment. 32 refs.; 8 figs.

44028 **(ITEP—182(1987)) Stark effect for the Rydberg states of hydrogen atom.** Popov, V.S.; Mur, V.D.; Sergeev, A.V.; Weinberg, V.M. (Gosudarstvennyj Komitet po Ispol'zovaniyu Atomnoj Ehnergii SSSR, Moscow. Inst. Teoreticheskoj i Ehksperimental'noj Fiziki). 1987. 25p. NTIS (US Sales Only), PC A03/MF A01. Order Number DE88703623/JAW.

The Stark shifts and widths for highly excited statesa, n=15-30, of hydrogen atom in strong electric field E are calculated (the E values exceed the classical ionization threshold E of the atom). The calculation method is summation of divergent perturbation series (PS) be means of Hermite-Pade approximants (HPA). The 1/n-expansion is also briefly discussed. The results of the calculation agree with the experimental data. 16 refs.; 5 figs.

44029 **(JINR-E—4-87-464) Cross sections for hydrogen muonic atomic processes in two-level approximation of the adiabatic framework.** Bubak, M.; Fajman, M.P. (Joint Inst. for Nuclear Research, Dubna (USSR). Lab. of Nuclear Problems; Gosudarstvennyj Komitet po Ispol'zovaniyu Atomnoj Ehnergii SSSR, Moscow. Inst. Atomnoj Ehnergii). (Joint Inst. for Nuclear Research, Dubna (USSR). Lab. of Nuclear Problems). 1987. 61p. NTIS (US Sales Only), PC A04/MF A01. Order Number DE88703691/JAW.

The phase-shifts and cross sections have been calculated in a broad collision energy range ($0.001 \leqq \epsilon \leqq 50$ eV) for the elastic scattering, isotopic exchange and spin-flip hydrogen muonic atomic processes. The so-called "simple approach" to the three-body problem with the Coulomb interaction in the adiabatic two-level approximation has been applied. The comparison of the obtained values with available results of the multichannel approximation shows that the accuracy of our calculations is about 10%. The presented set of the phases and cross sections together with corrections for the electron screening and molecular structure enables one to investigate kinetics of the muon-catalyzed fusion in any mixtures of hydrogen isotopes. 20 refs.; 21 figs.; 20 tabs.

44030 **(JINR-E—17-87-14) Nonclassical correlation between light beams in a Jaynes-Cummings-type model system.** Bogolyubov, N.N.; Fam Le Kien; Shumovskij, A.S. (Joint Inst. for Nuclear Research, Dubna (USSR). Lab. of Theoretical Physics). 1987. 6p. NTIS (US Sales Only), PC A02/MF A01. Order Number DE88703701/JAW.

The appearance of nonclassical correlation between light beams due to the interaction with an atom in a three-level two-mode Jaybes-Cummings-type model is examined. 14 refs.; 1 fig.

44031 **(JINR-E—17-87-23) Photon statistics in an N-level (N-1)-mode system.** Kozierowski, M.; Shumovskij, A.S. (Joint Inst. for Nuclear Research, Dubna (USSR). Lab. of Theoretical Physics). 1987. 19p. NTIS (US Sales Only), PC A03/MF A01. Order Number DE88703702/JAW.

Submitted to the journal Phys., A.

The characteristic and photon number distribution functions, the statistical moments of photon numbers and the correlations of modes are studied. The normally ordered variances of the photon numbers and the cross-correlation functions are calculated. 31 refs.; 3 figs.

44032 **(JINR-E—17-87-165) Squeezing in the multiphoton Jaynes-Cummings model.** Shumovskij, A.S.; Fam Le Kien; Aliskenderov, Eh.I. (Joint Inst. for Nuclear Research, Dubna (USSR). Lab. of Theoretical Physics). 1987. 7p. NTIS (US Sales Only), PC A02/MF A01. Order Number DE88703704/JAW.

Submitted to the journal Phys. Lett., A.

Squeezing states in the exactly soluble multiphoton Jaynes-Cummings model, where the atom is initially in the ground state and the fields are in a coherent state have been obtained. the immediate appearance of squeezing in a/sub 1/ for short times of interaction has been established. Due to the photon multiplicity and the suitable choice of the field intensity, the large magnitudes of squeezing have been obtained. 21 refs.; 2 figs.

44033 **(JINR-E—17-87-269) Exact results for emission from one and two atoms in an ideal cavity at multiphoton resonance.** Fam Le Kien; Shumovskij, A.S.; Tran Quang. (Joint Inst. for Nuclear Research, Dubna (USSR). Lab. of Theoretical Physics). 1987. 11p. NTIS (US Sales Only), PC A03/MF A01. Order Number DE88703705/JAW.

Submitted to the journal Phys., A.

The emission from the system of one or two two-level atoms in an ideal cavity with one mode at mutiphoton resonance is examined. Exact results for the two-time dipole correlation function and the time-dependent spectra of multiphoton-induced fluorescence are presented. 25 refs.

44034 **(JINR-E—17-87-410) Light squeezing in the two-atom one-mode model with multiphoton transitions.** Fam Le Kien; Kadantseva, E.P.; Shumovskij, A.S. (Joint Inst. for Nuclear Research, Dubna (USSR). Lab. of Theoretical Physics). 1987. 16p. NTIS (US Sales Only), PC A03/MF A01. Order Number DE88703706/JAW.

Submitted to the journal Phys. C.

The generation of squeezing states of the cavity radiation field in the two-atom one-mode model with multiphoton transitions is investigated. The time-dependent squeezing factors are calculated. The conditions for the otimum squeezing are shown. 20 refs.; 7 figs.

44035 **(JINR-E—17-87-437) Collective resonance Raman scattering of an intense laser field with phase and amplitude fluctuations.** Shumovskij, A.S.; Tanas, R.; Tran Quang. (Joint Inst. for Nuclear Research, Dubna (USSR). Lab. of Theoretical Physics). 1987. 20p. NTIS (US Sales Only), PC A03/MF A01. Order Number DE88703707/JAW.

Submitted to the journal Phys. A.

The resonance Raman scattering from a system of N three level atoms that are driven by a strong laser field with the phase and amplitude fluctuations is considered. The exact on-resonance steady-state solution to the atomic density matrix is obtained. The collective properties of the fluorescent spectrum for both the Rayleigh-type as well as the Raman-type processes are discussed. The collective narrowing of the one-atom spectral lines is predicted. 21 refs.

44036 **(JINR-E—17-87-854) Squeezing in collective Raman scattering.** Tran Quang; Shumovskij, A.S. (Joint Inst. for Nuclear Research, Dubna (USSR). Lab. of Theoretical Physics). 1987. 8p. NTIS (US Sales Only), PC A02/MF A01. Order Number DE88703709/JAW.

Submitted to the journal Phys. Lett., A.

The generation of a squeezed state via the collective Raman scattering in an intense external field is discussed. It is shown that squeezing is present only in the mixture of two sidebands of the Rayleigh line while it is absent for the Stokes line. The spectral analysis of the squeezing and the condition for receiving prefect squeezing is given. 26 refs.; 1 fig.

44037 **(JINR-R—6-87-757) Measurement of changes in nuclear charge radii of 2r by laser-induced resonance fluorescence.** Gangrskij, Yu.P.; Zemlyanoj, S.G.; Marinova, K.P.; Markov, B.N.; Khoang Tkhi Kim Khueh; Chan Kong Tam; Kul'dzhanov, B.K. (Joint Inst. for Nuclear Research, Dubna (USSR). Lab. of Nuclear Reactions; AN Uzbekskoj SSR, Tashkent. Inst. Yadernoj Fiziki). (Joint Inst. for Nuclear Research, Dubna (USSR). Lab. of Nuclear Reactions). 1987. 11p. (In Russian). NTIS (US Sales Only), PC A03/MF A01. Order Number DE88703751/JAW.

Submitted to the journal Zh. Ehksp. Teor. Fiz. .

The optical isotopic shifts of Zr stable isotopes have been measured in three atomic transitions of type 4d/sup 2/5s/sup 2/ -> 4d/sup 2/5s5p using the technique of laser-induced resonance fluorescence. The changes of nuclear mean-square charge radius $\Delta\langle r^2\rangle$ have been determined. The extracted values of $\Delta\langle r^2\rangle$ are compared to predictions of the droplet model. It is shown that the droplet model calculations can be made to agree with the experimental results, if changes of nuclear dynamical octupole deformation and of surface diffuseness parameter are taken into account. 31 refs.; 5 figs.; 5 tabs.

44038 **(JINR-R—17-87-119) Collective spontaneous emission from a system of two atoms with multiphoton transitions in a cavity.** Shumovskij, A.S.; Fam Le Kien; Aliskenderov, Eh.I. (Joint Inst. for Nuclear Research, Dubna (USSR). Lab. of Theoretical Physics). 1987. 10p. (In Russian). NTIS (US Sales Only), PC A02/MF A01. Order Number DE88703785/JAW.

Submitted to the journal J. Phys. .

Characteristics of the collective spontaneous emission of a system consisting of two two-level multiphoton-transition atoms excited in a lossless resonant cavity are calculated. The photon-multiplicity collective behaviour is found to affect the photon dynamics and statistics considerably. 31 refs.; 1 fig.

44039 **(KIYI—87-19) Calculation of capture ionization cross section in collisions of helium atoms with H/sup +/ and He/sup ++/ nuclei at large and mean energies.** Kovach, A.P.; Lazur, V.Yu.; Mashika, Yu.Yu. (AN Ukrainskoj SSR, Kiev. Inst. Yadernykh Issledovanij). 1987. 29p. (In Russian). NTIS (US Sales Only), PC A03/MF A01. Order Number DE88703797/JAW.

The process of capture with ionization A/sup Z(sub AB/ -> A/sup (Z(sub A-1)+/+B/sup 2+/+e at large and mean energies has been studied. The continuum destorted wave method, which has successfully been emplyed in the calculation of total and differential cross sections of "pure-exchange" and "pure-ionization" processes, has been used in the calculation of transition amplitude. The resulting expression include two factors, the one of which if the scattering amplitude with charge-exchange and it is equivalent to the result obtained by Gayet who has employed continuum destorted wave method. The second one describes bound-free transition in B/sup +/ ion. The results of calculation of cross sections for the He+p -> α+H+e and He+α -> α+He/sup +/+e processes have been compared with experimental data. 18 refs.; 2 figs.

44040 **(UCID—21386) Precise rotational alignment of x-ray transmission diffraction gratings.** Hill, S.L. (Lawrence Livermore National Lab., CA (USA)). 28 Mar 1988. Contract W-7405-ENG-48. 20p. NTIS, PC A03/MF A01;1; GPO Dep. Order Number DE88010599/JAW.

Gold transmission diffraction gratings used for x-ray spectroscopy must sometimes be rotationally aligned to the axis of a diagnostic instrument to within sub-milliradian accuracy. We have fabricated transmission diffraction gratings with high line-densities (grating period of 200 and 300 nm) using uv holographic and x-ray lithography. Since the submicron features of the gratings are not optically visible, precision alignment is time consuming and difficult to verify in situ. We have developed a technique to write an optically visible alignment pattern onto these gratings using a scanning electron microscope (SEM). At high magnification (15000 X) several submicron lines of the grating are observable in the SEM, making it possible to write an alignment pattern parallel to the grating lines in an electron-beam-sensitive coating that overlays the grating. We create an alignment pattern by following a 1-cm-long grating line using the SEM's joystick-controlled translation stage. By following the same grating line we are assured the traveled direction of the SEM electron beam is parallel to the grating to better than 10 μradian. The electron-beam-exposed line-width can be large (5 to 15 μm wide) depending on the SEM magnification, and is therefore optically visible. The exposed pattern is eventually made a permanent feature of the grating by ion beam etching or gold electroplating. The pattern can be used to accurately align the grating to the axis of a diagnostic instrument. More importantly, the alignment of the grating can be quickly verified in situ.

44041 **(UCID—21394) Nonlinear dynamics of the electron self-field interaction.** Ritchie, B.; Steiger, A. (Lawrence Livermore National Lab., CA (USA)). 18 Apr 1988. Contract W-7405-ENG-48. 9p. NTIS, PC A02/MF A01;1; GPO Dep. Order Number DE88010597/JAW.

There has been recent interest in the formulation of a nonperturbative theory of quantum electrodynamics (QED). In this report we critically discuss a recent theory of nonperturbative QED. We point out a difficulty with this theory and outline a theory which is free of this difficulty. Finally, computational schemes for implementing the theory are briefly discussed.

44042 **(UCRL—98043) Degradation of beam brightness by field emission from a cathode shroud.** Chen, Y.J.; Boyd, J.K.; Turner, W.C. (Lawrence Livermore National Lab., CA (USA)). 15 Mar 1988. Contract W-7405-ENG-48. 25p. (CONF-880494—1). NTIS, PC A03/MF A01;1; GPO Dep. Order Number DE88008345/JAW.

From Particle beam physics topical meeting; Baltimore, MD, USA (18 Apr 1988).

Degradation of beam brightness by field emission from the cathode shroud is studied by using particle-in-cell codes: DPC and ST. We find that emission from the space charge limited cathode is reduced due to the presence of the shroud electrons in the main beam. A scaling law for beam emittance is derived analytically. We find that emittance squared is linearly proportional to the fraction of beam current carried by field emitted electrons. The beam brightness is degraded by a factor of two when field emission electrons constitute 6.25% of the beam current. 5 refs., 9 figs., 1 tab.

44043 **Vibronic states of plutonium hexafluoride in the visible and near infrared spectral regions.** David, S.J.; Kim, K.C. (Materials Science and Technology Division, Los Alamos National Laboratory, Los Alamos, New Mexico 87545). *Journal of Chemical Physics;* **89**: No. 4, 1780-1786(15 Aug 1988).

The entire absorption spectrum of PuF_6 in the near IR and visible regions has been obtained at 0.5 cm^{-1} or higher resolution. A detailed analysis of the vibronic energy levels is presented and spectroscopic assignments of all observed transitions are made. The energy levels obtained from these spectroscopic measurements of the gas phase PuF_6 molecule are the most accurate values available. A comparison is shown of our assignments and results with the matrix-isolation experiment and available theoretical studies.

44044 **Why does the Aitken extrapolation often help to attain convergence in self-consistent field calculations?.** Cioslowski, J. (Los Alamos National Laboratory, Theoretical Division, Group T12, MS J569, Los Alamos, New Mexico 87545). *Journal of Chemical Physics;* **89**: No. 4, 2126-2127(15 Aug 1988).

The Aitken (three-point) extrapolation is one of the most popular convergence accelerators in the SCF calculations. The conditions that guarantee the Aitken extrapolation to bring about an unconditional convergence in the SCF process are examined. Classification of the SCF divergences is presented and it is shown

that the extrapolation can be expected to work properly only in the case of oscillatory divergence.

44045 Bonding and stabilities of small silicon clusters: A theoretical study of Si_7—Si_{10}. Raghavachari, K.; Rohlfing, C.M. (AT&T Bell Laboratories, Murray Hill, New Jersey 07974). *Journal of Chemical Physics;* **89**: No. 4, 2219-2234(15 Aug 1988).

Ab initio calculations have been performed to study the structures and energies of intermediate-sized silicon clusters (Si/sub n/, n = 7—10). All geometries have been optimized at the Hartree—Fock (HF) level of theory with the polarized 6-31G* basis set. The harmonic vibrational frequencies have been evaluated at the HF/6-31G* level of theory. Electron correlation effects have been included by means of fourth order Moeller—Plesset perturbation theory. The most stable structure for Si_7 is a pentagonal bipyramid and the lowest energy calculated structures for Si_8—Si_{10} correspond to capped octahedral or prismatic geometrical arrangements. The evolution of the cluster geometries with increasing size is discussed. Clusters containing four, six, seven, and ten atoms have been identified as "magic numbers" for small silicon clusters, both theoretically and experimentally. The hybridization and bonding in small silicon clusters is discussed. Our results are used to interpret the recent photoelectron spectra of negative silicon cluster ions.

44046 Statistical properties of the scanning simulation method for polymer chains. Meirovitch, H. (Supercomputer Computations Research Institute, Florida State University, Tallahassee, Florida 32306-4052). *Journal of Chemical Physics;* **89**: No. 4, 2514-2522(15 Aug 1988).

The scanning method is a computer simulation technique for polymer chains, which is especially suitable to handle chains with finite interactions and chains that are subject to various geometrical constraints. A chain is constructed step by step with the help of transition probabilities, obtained by scanning the possible continuations of the chain in future steps (called future chains). We discuss in detail the efficiency of the method and for that we study certain autocorrelation functions for three lattice models: self-avoiding walks (SAWs) on a square lattice, a random walk model for polymer adsorption and trails with attractive interactions. We demonstrate that for SAWs the scanning method is significantly more efficient than the related method of Rosenbluth and Rosenbluth. We also develop and test a new procedure in which the transition probabilities are obtained, not by exact enumeration of all the future chains, but from a relatively small sample of future chains, generated by another scanning procedure. This "double scanning" process is expected to be useful for complex macromolecules such as polypeptides.

44047 Raman pump/probe measurements of state-to-state energy transfer rates in the v = 1 state of H_2. Farrow, R.L.; Chandler, D.W. (Combustion Research Facility, Sandia National Laboratories, Livermore, California 94550). *Journal of Chemical Physics;* **89**: No. 4, 1994-1998(15 Aug 1988).

We have measured state-resolved rotational energy transfer rates of H_2 (v = 1) in collisions with H_2 (v = 0) at 295 K, using optical pump/probe techniques. A single rotational level was populated using stimulated Raman pumping, and the degree of collision-induced population transfer was monitored using either coherent anti-Stokes Raman spectroscopy (CARS) or resonance-enhanced multiphoton ionization spectroscopy (REMPI). The CARS and REMPI results are in good agreement; averages of the two sets of rates are 180 +- 27 x 10^6 s^{-1} $amagat^{-1}$ for j = 0→2 and 50 +- 8 x 10^6 s^{-1} $amagat^{-1}$ for j = 1→3. We also observed transfer of vibrational excitation from paraspin v = 1 states to ortho v = 0 states due to v—v exchange, measuring a rate of 1.9 +- 0.8 x 10^6.s^{-1} $amagat^{-1}$ for this process.

44048 Energy transfer from highly vibrationally excited azulene and azulene-d_8 to carbon dioxide. Jalenak, W.; Weston R.E. Jr.; Sears, T.J.; Flynn, G.W. (Department of Chemistry, Brookhaven National Laboratory, Upton, New York 11973). *Journal of Chemical Physics;* **89**: No. 4, 2015-2022(15 Aug 1988).

Time-resolved diode laser absorption spectroscopy has been used to study vibrational-to-vibrational energy transfer from highly excited azulene and azulene-d_8 to carbon dioxide. The energetic azulene molecules were prepared by internal conversion (S_2→S_0) after excitation into the S_2 state by a pulsed laser source of 337 nm photons. Relative populations of CO_2 vibrational modes were determined and compared with predictions of a statistical model. The total vibrational energy transferred to CO_2 was determined to be about 25% of the initial azulene energy. Similar experiments were carried out using 248 nm photons to excite azulene in the region of the S_4 state.

44049 Electronic structure of the Fe_2 molecule in the local-spin-density approximation. Dhar, S.; Kestner, N.R. (Department of Chemistry, Louisiana State University, Baton Rouge, Louisiana 70803). *Physical Review [Section] A: General Physics;* **38**: No. 3, 1111-1119(1 Aug 1988).

Ab initio self-consistent all-electron spin-polarized calculations have been performed for the ground-state properties of the Fe_2 molecule using the local-spin-density approximation. A Gaussian orbital basis is employed and all the two-electron integrals are evaluated analytically. The matrix elements of the exchange-correlation potential are computed numerically. The total energy, the binding energy, the equilibrium distance, vibrational frequency, and the ground-state configurations are reported and compared with other calculations and experimental results.

44050 Relativistic equation for the multielectron atom. Broyles, A.A. (University of California, Lawrence Livermore National Laboratory, Livermore, California 94550). *Physical Review [Section] A: General Physics;* **38**: No. 3, 1137-1148(1 Aug 1988).

Equations are derived for the calculation of the relativistic propagator for a multielectron atom consisting of n spin-1/2 point fermions of different masses. A Hamiltonian is found whose eigenfunctions approximately diagonalize the propagator. This Hamiltonian reduces to that found by Salpeter [Phys. Rev. 87, 328 (1952)] for two fermions (the hydrogen atom) and appears to have the proper structure to reduce to the nonrelativistic Coulomb Hamiltonian in that limit. Formulas are presented for calculating improvements to the propagator to any order.

44051 Two-photon spectroscopy of singlet autoionizing levels of atomic sulfur. Pratt, S.T. (Argonne National Laboratory, Argonne, Illinois 60439). *Physical Review [Section] A: General Physics;* **38**: No. 3, 1270-1278(1 Aug 1988).

Two-photon excitation from the $^1D_2$ level of atomic sulfur was used to probe the previously unobserved, even-parity singlet levels in the region between the two lowest ionization thresholds. Several new Rydberg series were observed and assigned to the ($^2D^0$)np and ($^2D^0$)nf configurations. Although these levels are energetically allowed to autoionize into the $^4S^0+e^-$ continuum, autoionization is forbidden within LS coupling, resulting in very narrow linewidths.

44052 Numerical multiconfiguration Hartree-Fock studies of atomic photoionization cross sections: Dynamical core-polarization effects in atomic sodium. Saha, H.P.; Froese-Fischer, C.; Langhoff, P.W. (Department of Physics, University of Central Florida, Orlando, Florida 32816-0993 and Supercomputer Computations Research Institute, Florida State University, Tallahassee, Florida 32306-4052). *Physical Review [Section] A: General Physics;* **38**: No. 3, 1279-1285(1 Aug 1988).

Completely numerical multiconfiguration Hartree-Fock (MCHF) methods are used to calculate the photoionization cross section of atomic sodium in its ground state for incident photon energies in the single-channel region between the first (3s/sup -1/)^{1}S and second (2p/sup -1/)^{3}P ionization thresholds. Particular attention is focused on obtaining accurate cross-sectional values in the threshold and Cooper-minimum region up to ~5 eV kinetic energy, where there is the possibility of a sensitivity of results to the quality of the ground-state wave function and final-state potential, and on incorporating the effects of dynamical core polarization in the final state, which are particularly important in the ~5—15-eV kinetic energy region. These attributes are incorporated in the MCHF procedure by including appropriate doubly excited configurations in

the ground state and L^2 polarization pseudostates in the final-state wave function. Provision is made in the final-state calculation for the simultaneous variational determination of the continuum function, of the orbitals comprising a basis for the L^2 polarization pseudostates, and of the configuration-mixing coefficients at each photon energy. The cross sections calculated in this way using length and velocity forms are in good agreement over the entire incident photon energy range considered, suggesting that converged values may be obtained in this interval from the present development. The very small effects of spin-orbit interaction on the photoionization cross section are neglected in the present calculations, in accordance with previously reported observations.

44053 **Impact broadening of the dtμ formation resonances.** Padial, N.T.; Cohen, J.S.; Leon, M. (Los Alamos National Laboratory, Los Alamos, New Mexico 87545). *Physical Review [Section] A: General Physics;* **38**: No. 3, 1172-1176(1 Aug 1988).

The density dependence of dtμ molecular formation has been treated as a line-broadening process in the impact approximation. In the present paper, elastic cross sections and their coherent difference are calculated for D_2+D_2 and $(dt\mu)dee+D_2$ collisions. Together with the rotationally inelastic cross sections previously calculated [Phys. Rev. A 37, 329 (1988)] using the same accurate intermolecular potential, this provides all cross sections needed for evaluation of the width in the impact approximation. The impact width is dominated by elastic scattering and, at the temperature 23 K and liquid-hydrogen density, has the value 14 meV, which is more than three times the previously calculated value.

44054 **Contours of constant scattering angle.** Hanson, A.L.; Gigante, G.E.; Meron, M. (Brookhaven National Laboratory, Upton, New York 11973 and Physics Department, University of Rome, Rome, Italy). *Physical Review Letters;* **61**: No. 2, 135-137(11 Jul 1988).

Traditionally, radiation-scattering experiments are conceived in terms of cylindrical geometry where the symmetry axis is the line between the source and the target. When the target becomes extended, as is the case in many real-life measurements, the analysis or the prediction of spectra becomes difficult. By definition of the axis of symmetry as being between the source and the detector, the extended target can be described in toroidal geometry with the surface of each toroid being a contour of constant scattering angle. With the scattering cross section constant over each contour, the calculation of total scattering intensities is greatly simplified.

44055 **Characterization of a cesium surface ionization source with a porous tungsten ionizer. I.** Alton, G.D. (Oak Ridge National Laboratory, P. O. Box X, Building 6000, Oak Ridge, Tennessee 37831). *Review of Scientific Instruments;* **59**: No. 7, 1039-1044(Jul 1988).

A cesium surface ionization source of the type and geometry customarily used in conjunction with sputter-type negative heavy ion sources has been characterized. Measurements have been made of positive-ion production and probabilities of ionization as functions of extraction voltage and cesium oven temperature for ionizer porosities of 0.7 and 0.8. The perveance P of the source, when operated in the space-charge-limited regime with the rho = $0.7rho_0$ ionizer, is found from experiment to be 7.61×10^{-4} μP, while that for the rho = $0.8rho_0$ ionizer is 1.92×10^{-4} μP. These values are lower by factors of 3.88 and 15.53, respectively, than those predicted by numerical solution to Poisson's equation for full area emission from the source. Positive-ion current versus ionizer temperature data are also presented along with mechanical design features of the source.

44056 **Aspects of negative-ion generation and extraction from a refocus geometry cesium sputter negative-ion source. II.** Alton, G.D. (Oak Ridge National Laboratory, P. O. Box X, Building 6000, Oak Ridge, Tennessee 37831). *Review of Scientific Instruments;* **59**: No. 7, 1045-1052(Jul 1988).

The basic parameters of the refocus geometry cesium sputter ion source for the production of negative ions from a low-sputtering material (carbon) and a high-sputtering material (copper) have been measured. The question of the influence of sample temperature on the negative-ion generation process has been addressed. Negative-ion yields from carbon samples are found to be weakly dependent on temperature over a range from 26° to 400 °C, while those from copper samples are found to be essentially independent of temperature over a range of 26° to 200 °C. The results of these investigations indicate that (1) sample temperature does not strongly influence negative formation in these sources, and (2) the maximum negative-ion yields for a given sample are dependent on both cesium-ion energy and positive-ion current. In addition to these data, the negative-ion extraction optics of the source are briefly discussed and cursory estimates of the probabilities for negative-ion formation presented.

44057 **Spectrum of Au I in the infrared using a Fourier-transform spectrometer.** George, S.; Grays, A.; Engleman R. Jr. (Department of Physics-Astronomy, California State University, Long Beach, Long Beach, California 90840). *Journal of the Optical Society of America B: Optical Physics;* **5**: No. 7, 1500-1502(Jul 1988).

High-resolution Fourier-transform spectra of a gold hollow cathode in the 1—5.3-μm region have been used to improve the energy-level analysis of Au I. The analysis of 29 new near-infrared lines also yielded hyperfine-splitting constants for three Au I levels.

44058 **Spectra in the 60—345-A wavelength region of the elements Fe, Ni, Zn, Ge, Se, and Mo injected into the Princeton Large Torus tokamak.** Wouters, A.; Schwob, J.L.; Suckewer, S.; Seely, J.F.; Feldman, U.; Dave, J.H. (Princeton Plasma Physics Laboratory, Princeton University, Princeton, New Jersey 08544). *Journal of the Optical Society of America B: Optical Physics;* **5**: No. 7, 1520-1527(Jul 1988).

High-resolution spectra of the elements Fe, Ni, Zn, Ge, Se, and Mo injected into the Princeton Large Torus tokamak were recorded by the 2-m Schwob—Fraenkel soft-x-ray multichannel spectrometer. Spectra were recorded every 50 msec during the times before and after injection. The spectral lines of the injected element were very strong in the spectrum recorded immediately after injection, and the transitions in the injected element were easily distinguished from the transitions in the intrinsic elements (C, O, Ti, Cr, Fe, and Ni). An accurate wavelength scale was established using well-known reference transitions in the intrinsic elements. The spectra recorded just before injection were subtracted from the spectra recorded after injection, and the resulting spectrum was composed almost entirely of transitions from the injected element. A large number of $\Delta n = 0$ transitions between the ground and the first excited configurations in the Li I through K I isoelectronic sequences of the injected elements were identified in the wavelength region 60 to 345 A.

44059 **New experimental results on muon catalyzed fusion in low density deuterium-tritium gas.** Kammel, P.; Breunlich, W.H.; Cargnelli, M.; Marton, J.; Pawlek, P.; Werner, J.; Zmeskal, J.; Crowe, K.M.; Kurck, J.; Sherman, R.H. (Lawrence Berkeley Lab., Univ. of California, Berkeley, CA (US)). pp 42-52 of Contributions to the muon catalyzed fusion workshop. Idaho Falls, ID; Idaho National Engineering Lab. (1985). (CONF-840660—).

From Workshop on muon-catalyzed fusion reactions; Jackson, WY, USA (7 Jun 1984).

The general theoretical ideas for resonant formation of muonic hydrogen molecules have been discussed. The authors take a closer look at this remarkable process, which is the starting point for the renewed interest in the field of muon catalyzed fusion. In the case of pure deuterium, where the resonant formation process was first discovered, the recent work of the authors' group established muon catalysis as a powerful experimental method for the investigation of mesomolecular processes and bound muonic systems. An accurate spectroscopy allows the determination of the binding energy and even the hyperfine structure of a dμd state within 1 meV or better (this corresponds to some ppm of the typical mesomolecular binding energy). These experiments also provide the long missing accurate experimental information about the transition rate between the hyperfine states of muonic deuterium. This detailed information about mesoatomic and mesomelecular processes has considerable impact on the experiments on the elementary muon capture process in deuterium.

6404 Fluid Physics

REFER ALSO TO CITATION(S) 43663, 43819

44060 (DOE/ET—53088-327) Nonlinear evolution of a force-free arcade field driven by shear flow. Bekki, N.; Tajima, T.; Van Dam, J.W.; Mikic, Z.; Barnes, D.C.; Schnack, D.D. (Texas Univ., Austin (USA). Inst. for Fusion Studies). Jul 1988. Contract FG05-80ET53088. 14p. (IFSR—327). NTIS, PC A03/MF A01; 1; GPO Dep. Order Number DE88013560/JAW.

The nonlinear evolution of a force-free magnetic field driven by slow shear flow on a boundary is investigated analytically and numerically. The Woltjer-Taylor theory is generalized to obtain the time-dependent magnetohydrodynamic (MHD) solution for the nonlinear force-free fields driven by shear flow. This solution agrees well with our resistive MHD simulations, which show that the force-free arcade field in a solar coronal plasma evolves quasi-statically through a series of force-free states before reconnection occurs. 14 refs., 2 figs.

44061 (SAND—87-2053C) Foam rheology: A model of viscous effects in shear flow. Kraynik, A.M.; Reinelt, D.A. (Sandia National Labs., Albuquerque, NM (USA)). 1988. Contract AC04-76DP00789. 4p. (CONF-880827—4). NTIS, PC A02. Order Number DE88005733/JAW.

From 10. international congress on rheology; Sydney, Australia (14 Aug 1988).

Foams consisting of gas bubbles dispersed in a continuous network of thin liquid films display a remarkable range of rheological characteristics that include a finite shear modulus, yield stress, non-Newtonian viscosity, and slip at the wall. Progress in developing micromechanical theories to describe foam rheology has depended upon two-dimensional models, which in most cases are assumed to have perfectly ordered structure. Princen accounted for surface tension and geometrical effects, and analyzed the nonlinear elastic response of a spatially periodic foam in simple shear. His analysis has been extended to account for more general deformations. Khan and Armstrong and Kraynik and Hansen have proposed ad hoc models for viscous effects in foam rheology. Their models capture numerous qualitative phenomena but incorporate relaxation mechanisms based upon overly simplified assumptions of liquid flow in the thin films. Mysels, Shinoda, and Frankel considered soap films with interfaces that are inextensible due to the presence of surfactants. They analyzed the primary flow that occurs when such films are slowly withdrawn from or recede into essentially static junction regions such as the Plateau borders in a foam. Adopting this mechanism, Schwartz and Princen considered small periodic deformations of a foam and calculated the energy dissipation due to viscous flow in the thin films. In the following, we also adopt the basic interfacial and viscous mechanisms introduced by Mysels et al. and analyze simple shearing deformations of finite amplitude. The configuration and effective stress of the foam are determined. Under these deformation conditions, the foam is a nonlinear viscoelastic material. Results for the uniform expansion of a foam are also presented. 11 refs., 3 figs.

44062 Framework for modeling the cathode fall illustrated with a single beam model. Sommerer, T.J.; Lawler, J.E.; Hitchon, W.N.G. (Department of Physics, University of Wisconsin, Madison, Wisconsin 53706). *Journal of Applied Physics;* **64**: No. 4, 1775-1780(15 Aug 1988).

A framework for a model of the cathode fall region of a dc glow discharge is presented, and a simple model is solved as an illustration. An extremum condition independent of the model is placed on the electric field behavior to produce a unique solution that agrees with experiment. The zeroth and second moments of the Boltzmann equation are solved for the electrons with a self-consistent electric field. A single-beam model with only two parameters (number density and beam velocity) is assumed for the electron distribution function. Ion motion is modeled with a parametric fit to known ion mobilities. The model is solved for conditions corresponding to the experimental results and to Monte Carlo simulations of Doughty, Den Hartog, and Lawler [Phys. Rev. Lett. 58, 2668 (1987)]. The results are in good qualitative and "factor-of-two" quantitative agreement with the published results.

44063 Transport properties of polydisperse fluids. I. Shear viscosity of polydisperse hard-sphere fluids. Xu, J.; Stell, G. (Department of Mechanical Engineering, State University of New York at Stony Brook, Stony Brook, New York 11794). *Journal of Chemical Physics;* **89**: No. 4, 2344-2355(15 Aug 1988).

The shear viscosity expressions for a polydisperse hard-sphere fluid in both the dilute and dense fluid regions have been obtained as the solution of a set of linear integral equations in the Enskog transport theory. In the monodisperse limit we recover the known Enskog result. Explicit analytical solutions have been obtained for the special case of equal-mass particles. For general mass-size distributions, a simple numerical method has been proposed. Computations have been performed for a mass-size relation of power-law form. The two size distributions we have looked at are the Schulz distribution and the log-normal distribution. It is found that both distributions show similar effects on the shear viscosity. In the dilute-gas region, for each given fractal dimension, there exists a critical variance of the size distribution at which the shear viscosity attains a maximum. In the dense-gas region, the shear viscosity increases as the variance and the density increase except for the low density and the high fractal-dimension region where the shear viscosity attains a minimum at some particular variance. The shear viscosity diverges at a close-packing density that decreases with increasing variance.

44064 Validation of the Sharp—Wheeler bubble merger model from experimental and computational data. Glimm, J.; Li, X.L. (Courant Institute of Mathematical Sciences, New York University, New York, New York 10012). *Physics of Fluids;* **31**: No. 8, 2077-2085(Aug 1988).

A statistical model to describe the late time chaotic behavior of a Rayleigh—Taylor unstable interface was introduced by Sharp and Wheeler [Physica D 12, 3 (1984); (private communication)]. Here the focus is on effective computations using this model and the comparison of the model with experiment. The numerical solution of the model shows that the height of the mixing layer, in which the bubbles of the light fluid penetrate the heavy fluid, is in a constant acceleration. This result agrees with the experiments of Read [Physica D 12, 45 (1984)].

44065 Microconvection effects at double-diffusive gradient zone boundaries. Hull, J.R.; Katti, Y. (Argonne National Laboratory, Argonne, Illinois 60439-4825). *Physics of Fluids;* **31**: No. 8, 2368-2370(Aug 1988).

Microconvection in double-diffusive gradient zones is predicted to occur near the zone boundaries because of effects of boundary undulation and temperature modulation caused by impinging thermals in adjacent convecting zones. The equations that govern convective motion in a double-diffusive horizontal slab are solved for boundary conditions that incorporate these effects. Solution of these equations predicts a weakened salinity gradient near the gradient zone boundary between the rising thermals. When the salinity gradient is too weak, instability occurs, taking the form of descending plumes, which are seen in experiments.

44066 Hamiltonian structure for two-dimensional hydrodynamics with nonlinear dispersion. Holm, D.D. (Center for Nonlinear Studies and Theoretical Division, Los Alamos National Laboratory, Los Alamos, New Mexico 87545). *Physics of Fluids;* **31**: No. 8, 2371-2373(Aug 1988).

A Hamiltonian formulation using a noncanonical Poisson bracket is presented for a recently proposed model (Dokl. Akad. Nauk SSSR 293, 818 (1985) [Sov. Phys. Dokl. 32, 262 (1987)]) of two-dimensional shallow-water hydrodynamics with nonlinear dispersion. Nonlinear integral invariants for this model are found to be in the kernel of the noncanonical Poisson bracket. A generalized Kelvin theorem is also given for the model.

44067 Spinning "snowballs" in superfluid ^{4}He. Elser, V.; Platzman, P.M. (AT&T Bell Laboratories, Murray Hill, New Jersey 07974). *Physical Review Letters;* **61**: No. 2, 177-179(11 Jul 1988).

We propose a simple mechanism that generates nonparabolicity in the dispersion of the positive charge carrier (snowball) in su-

perfluid ^{4}He. Specifically, we pursue the consequences of a model where (1) the snowball behaves as a rigid rotator and (2) the hydrodynamic contribution to its mass (with rotator axes fixed) is anisotropic. The nonparabolicity that we calculate leads to a linear temperature variation of the snowball effective mass. The model is consistent with recent measurements if we assume a mass anisotropy of (9—13)%. An additional T^3 mass enhancement by long-wavelength phonons is negligible for the snowball but may be observable for the negative charge carrier.

6450 High Energy Physics

44068 (DOE/ER—0372) High Energy Physics Computer Networking: Report of the HEPNET Review Committee. (USDOE Office of Energy Research, Washington, DC. High Energy Physics Div.). Jun 1988. 133p. NTIS, PC A07/MF A01; 1; GPO Dep. Order Number DE88012712/JAW.

This paper discusses the computer networks available to high energy physics facilities for transmission of data. Topics covered in this paper are: Existing and planned networks and HEPNET requirements. (LSP)

44069 (KEK—87-20) Proceedings of the meeting on physics at TeV energy scale. Hagiwara, K.; Hidaka, K. (eds.). (National Lab. for High Energy Physics, Oho, Ibaraki (Japan)). Nov 1987. vp. (CONF-8705290—). NTIS (US Sales Only), PC A12/MF A01. Order Number DE88780084/JAW.

From Meeting on physics at TeV energy scale; Oho, Japan (28 May 1987).

Individual papers in these proceedings are abstracted separately. (LEW)

6451 Particle Interactions And Properties - Experimental

REFER ALSO TO CITATION(S) 44103, 44213, 44214

44070 (BNL—41369) Study of quark flavor-dependence in exclusive reactions at large momentum transfers. Carroll, A.S.; Appel, R.; Barton, D.S.; Bunce, G.; Kmit, M.; Makdisi, Y.I.; Baller, B.R.; Blazey, G.C.; Courant, H.; Fang, G. (Brookhaven National Lab., Upton, NY (USA)). 1988. Contract AC02-76CH00016. 10p. (CONF-880867—1). NTIS, PC A03/MF A01; 1; GPO Dep. Order Number DE88012139/JAW.

From 24. international Rochester conference on high energy physics; Munich, F.R. Germany (4 Aug 1988).

The measurement of exclusive reactions at large momentum transfers provides an important testing ground for models of hard quark-quark scattering. We have measured cross sections or set upper limits for 12 meson-bryon (π/sup +-/p $\rightarrow$ pπ/sup +-/, p{rho}/sup +-/, $\pi^+\Delta$/sup +-/, $K^+\Sigma$/sup +-/, π/sup {minus}/p $\rightarrow$ Λ^0/Σ^0K^0, K/sup +-/p $\rightarrow$ pK/sup +-/) and 2 baryon-baryon (p/sup +-/p $\rightarrow$ pp/sup {plus←minus}) reactions near 90{degree} C.M. by studying the flavor-dependence of these 2 exclusive reactions at t = -9(GeV/c){sup 2}, we have been able to demonstrate in a perturbative QCD picture that the quark-interchange mechanism is dominant over gluon exchange and quark-antiquark annihilation. We will also present preliminary results on many of these reactions at t = -5(GeV/c){sup 2} with better resolution and statistical precision. 145 refs., 3 figs.

44071 (BNL—41416) Towards an amplitude analysis of exclusive $\gamma\gamma$ processes. Pennington, M.R. (Brookhaven National Lab., Upton, NY (USA)). Jun 1988. Contract AC02-76CH00016. 30p. (CONF-8804147—3). NTIS, PC A03/MF A01; 1; GPO Dep. Order Number DE88012853/JAW.

From 8. international workshop on photon-photon collisions; Shoresh, Israel (24 Apr 1988).

The potential of two photon processes to shed light on the parton content of resonances, we maintain, can only be realized in practice by moving towards an Amplitude Analysis of experimental data. By using the process $\gamma\gamma \rightarrow \pi\pi$ as an example, the way to do this is discussed. Presently claimed uncertainties in the $\gamma\gamma$ width of even the well-known f_2 (1270) are shown to be over-optimistic and the fitted couplings of the overlapping scalar states in the 1 GeV region meaningless. Only the use of Amplitude Analysis techniques on the new higher statistics data from SLAC and DESY can resolve these uncertainties and lead to definite and significant results. 37 refs., 18 figs.

44072 (CERN-EP—83-141) Strangeness suppression at collider energy. Mueller, T. (European Organization for Nuclear Research, Geneva (Switzerland)). 16 Sep 1983. 11p. (CONF-830689—13). NTIS (US Sales Only), PC A03. Order Number TI88012582/JAW.

From 14. international symposium on multiparticle dynamics; Lake Tahoe, NV, USA (22 Jun 1983).

The strangeness suppression factor λ, defined as the ratio of the numbers of s,{bar s} to u,{bar u} or d,{bar d} quarks in the hadronic vacuum is determined for non-diffractive p{bar p} collisions at $\sqrt{s} = 540$ GeV using data from the streamer chamber experiment UA5. It has been found that in p{bar p}, pp reactions λ rises continuously from {approximately}0.15 at $\sqrt{s}$ {approximately} 5 GeV to 0.39 +- 0.07 at $\sqrt{s} = 540$ GeV. 26 refs., 4 figs.

44073 (CERN/EP—87-194) Review of $\sin^2 L$/sub W/ measurements from neutrino scattering. Wachsmuth, H. (European Organization for Nuclear Research, Geneva (Switzerland)). 21 Oct 1987. 6p. (CONF-870632—17). NTIS (US Sales Only), PC A02; 1; GPO Dep. Order Number DE88012602/JAW.

From International Europhysics conference on high energy physics; Uppsala, Sweden (25 Jun 1987).

One event consisting of a single 380 MeV electron found in Gargamelle 14 years ago established the existence of neutrino induced Neutral Current (NC) interactions and bounded the Standard Electroweak Model (SEM)'s parameter $x = \sin^2\theta$/sub w/ between 0.1 and 0.6. This review will show that with present day techniques the measurement of this parameter has reached a precision which equals the uncertainty due to the theoretical interpretation of such experiments. After a brief reminder of notations the various neutrino experiments and their results will be reviewed with some insistance on neutrino scattering off isoscalar targets. The review will be concluded with a comparison of x obtained from the W boson mass and with an outlook. 31 refs., 2 figs., 1 tab.

44074 (CERN-EP—87-206) QED interactions in the supercritical fields of aligned crystals at TeV energies. Belkacem, A.; Bologna, G.; Chevallier, M.; Cue, N.; Gaillard, M.J.; Genre, R.; Gouanere, M.; Kimball, J.C.; Kirsch, R.; Marsh, B. (European Organization for Nuclear Research, Geneva (Switzerland)). 10 Nov 1987. 11p. (CONF-8709234—2). NTIS (US Sales Only), PC A03; 1; GPO Dep. Order Number DE88012606/JAW.

From Workshop on the experimental program at UNK; Protovino, USSR (14 Sep 1987).

A series of experiments at CERN which confirmed strong field effects in the interactions of ~0.1-TeV electrons and photons with aligned crystals have naturally led us to propose extending the studies to TeV energy range. The results at 0.1 TeV have shown that the interaction of photons with the continuum electric fields of aligned crystals (electron pair photoproduction) is well characterized by the standard QED theory in supercritical macroscopic magnetic fields. There are, however, some aspects of interactions with electrons which deviate significantly from these QED predictions. Indeed in a crystal the radiation of ultrarelativistic electrons is due to the presence of macroscopic electrical fields. An equivalent magnetic field can always be found which induces the same local curvature for the electron trajectory. 3 refs., 5 figs.

44075 (CERN-EP—88-02) Proton-antiproton collider physics: Experimental aspects. DiLella, L. (European Organization for Nuclear Research, Geneva (Switzerland)). 6 Jan 1988. 61p. (CONF-8708230—3). NTIS (US Sales Only), PC A04; 1; GPO Dep. Order Number DE88012610/JAW.

From NATO advanced studies institute summer school on particle physics; Cargese, France (3 Aug 1987).

These lectures review recent experimental results of relevance to the Standard Model of the electroweak interaction, which have been obtained at the CERN p{bar p} Collider in a series of data-taking runs between 1982 and the end of 1985. This review includes the measurement of the W and Z masses, their decay and production properties, and also searches for the top quark and other possible new particles postulated by a variety of theoretical models. 61 refs., 33 figs., 4 tabs.

44076 **(CERN-EP—88-08) Review of recent experimental results on hadroproduction of heavy quarks.** Weilhammer, P. (European Organization for Nuclear Research, Geneva (Switzerland)). 18 Jan 1988. 30p. (CONF-8709152—4). NTIS (US Sales Only), PC A03; 1; GPO Dep. Order Number DE88012611/JAW.

From 18. international symposium on multiparticle dynamics; Tashkent, USSR (8 Sep 1987).

Recent experimental results on hadroproduction of heavy flavour particles are reviewed. After a very short overview of the presently prevailing theoretical ideas describing hadroproduction of heavy flavours, current experimental techniques used in heavy flavour search experiments are briefly described. New results on differential and total cross-sections for charm and beauty production and on the A-dependence of the charm cross-section follow. 38 refs., 34 figs.

44077 **(IFVE-OEF—87-154) Study on the proton diffraction structure in the p-barp->p-bar(p2π/sup +/2π/sup -/)/sub D/ reaction at 32 GeV/c.** Bogolyubskij, M.Yu.; Borovikov, A.A.; Bumazhnov, V.A. and others. (Gosudarstvennyj Komitet po Ispol'zovaniyu Atomnoj Ehnergii SSSR, Serpukhov. Inst. Fiziki Vysokikh Ehnergij). 1987. 24p. (In Russian). NTIS (US Sales Only), PC A03/MF A01. Order Number DE88703541/JAW.

Submitted to the journal Sov. J. Nucl. Phys. .

Effective mass spectra for p2π/sup +/2π/sup -/ diffractive system (DS) and for the pionic component 2π/sup +/2π/sup -/ (PC) and also events structure in the main axis systems were investigated. Leading effect for the secondary proton was detected. The <p/sub t/> rise for pions and protons with increasing DS mass M/sub x/ is observed. For the first time, the charge transition value <Q> for DS was measured and an asymptotic estimation <Q>=0+-0.15 was obtained. Data sample contradicts some diffraction models and might be explained with the pomeron interaction using proton gluon component. The influence of nondiffractive background on the obtained results was carefully analysed. 30 refs.; 10 figs.; 3 tabs.

44078 **(IFVE-ONF—87-82) Influence of nonperturbative effects on the scaling violation in neutrino interactions at Q/sup 2/=2-100 GeV/sup 2/.** Ammosov, V.V.; Burtovoj, V.S.; Gapienko, V.A. and others. (Gosudarstvennyj Komitet po Ispol'zovaniyu Atomnoj Ehnergii SSSR, Serpukhov. Inst. Fiziki Vysokikh Ehnergij). 1987. 4p. NTIS (US Sales Only), PC A02/MF A01. Order Number DE88703542/JAW.

Submitted to the jornal Pis'ma JETP.

Combined analysis of nonperturbative and perturbative contributions to the scaling violation of nucleon structure functions, measured in neutrino interactions at Q/sup 2/=2-100 GeV/sup 2/, has been fulfilled. The value of the QCD parameter A/sub MtilderS/ has been found to be 0.50+-0.11 (stat.) GeV. Nonperturbative contribution has a negative sign and its x-dependence is described by x/sup 2//(1-x) form quite well. 11 refs.; 2 figs.

44079 **(ITEF—125(1987)) Searches for diproton resonances in proton-nucleus interactions at 7.5 GeV/c.** Vorob'ev, L.S.; Gavrilov, V.B.; Goryainov, N.A. and others. (Gosudarstvennyj Komitet po Ispol'zovaniyu Atomnoj Ehnergii SSSR, Moscow. Inst. Teoreticheskoj i Ehksperimental'noj Fiziki). 1987. 15p. (In Russian). NTIS (US Sales Only), PC A03/MF A01. Order Number DE88703597/JAW.

Proton pairs formed in pC, pCu and pPb interactions at 7.5 GeV/c at an angle of 90 deg in laboratory system were studied. In the researched effective mass range from 1.9 to 2.0 GeV/c/sup 2/ statistically significant irregularities were not found. Within the scope of different assumptions about production mechanism the estimations of diproton resonance production cross-section upper limits were made. 16 refs.; 7 figs.

44080 **(ITEF—161(1987)) Experiment to search for tachyon production in π/sup -/p interactions at 4.5 GeV/c.** Perepelitsa, V.F. (Gosudarstvennyj Komitet po Ispol'zovaniyu Atomnoj Ehnergii SSSR, Moscow. Inst. Teoreticheskoj i Ehksperimental'noj Fiziki). 1987. 28p. (In Russian). NTIS (US Sales Only), PC A03/MF A01. Order Number DE88703600/JAW.

The results of the experiment to search for charged tachyon production by PI/sup -/ mesons with the 4.5 GeV/c momenta in a liquid-hydrogen bubble chamber are presented. Analysis of the events chosen is carried out by the method of missing masses. A definite excess of events-candidates, which is difficultly explained by all known backgrounds, is observed. Nevetherless, as interpretation of these events is indefinite, the results obtained are considered as establishment of the upper limits to charged tachyon production cross sections. These limits are on the ~10/sup -4/ level from the total cross section of PI/sup -/p interactions, that is considerably lower than the upper limits established up to now to probabilities of tachyon production in hadron reactions. 20 refs.; 12 figs.

44081 **(ITEF—186(1987)) Search for the K/sub S/->2γ decay.** Balats, M.Ya.; Berezin, V.M.; Bogdanov, E.T. and others. (Gosudarstvennyj Komitet po Ispol'zovaniyu Atomnoj Ehnergii SSSR, Moscow. Inst. Teoreticheskoj i Ehksperimental'noj Fiziki). 1987. 16p. (In Russian). NTIS (US Sales Only), PC A03/MF A01. Order Number DE88703609/JAW.

The upper limit for relative probability of K/sub S/->2γ decay is obtained at the magnetoradiation spectrometer. Γ (K/sub S/->2γ)/Γ(K/sub S/->all)<1.3x10/sup -5/ is determined at 90% confidence level without account of interference of K/sub L/->2γ and K/sub S/->2γ decay amplitudes. 12 refs.; 5 figs.

44082 **(ITEP—155(1987)) Neutrino masses from the data on second neutrino burst observed from supernova SN 1987A.** Krivoruchenko, M.I. (Gosudarstvennyj Komitet po Ispol'zovaniyu Atomnoj Ehnergii SSSR, Moscow. Inst. Teoreticheskoj i Ehksperimental'noj Fiziki). 1987. 5p. NTIS (US Sales Only), PC A02/MF A01. Order Number DE88703617/JAW.

Masses of diagonal neutrinos are extracted from the data on second neutrino burst observed from supernova SN 1987 a. The average mass of electron neutrino is found to be very close to 22 eV. 10 refs.

44083 **(JINR-E—1-87-142) Universal four-dimensional hadron jets and the observability of colour charges.** Baldin, A.M.; Didenko, L.A.; Grishin, V.G.; Kuznetsov, A.A.; Metreveli, Z.V. (Joint Inst. for Nuclear Research, Dubna (USSR). Lab. of High Energy; Tbilisskij Gosudarstvennyj Univ. (USSR)). (Joint Inst. for Nuclear Research, Dubna (USSR). Lab. of High Energy). 1987. 15p. NTIS (US Sales Only), PC A03/MF A01. Order Number DE88703675/JAW.

Submitted to the 11. Intern. Conf. on Particles and Nuclei, Kyoto, 20 - 24 Apr 1987.

A new definition of the jets as clusters in the four-velocity space has been used to make an invariant analysis of the jet production processes in ν-barN collisions for the three energy intervals of the hadron system: <W>=3.5; 4.9; 8.0 GeV. The obtained results are compared with the characteristics of the four-dimensional jets in various types of interactions: pp, p-barp, π/sup -/p, π/sup -/C, pC and pTa at energies from 6 to 205 GeV. The characteristics of the four-dimensional jets in soft and hard interactions are shown to be universal, i.e. independent of neither the type of the fragmenting system (p, p-bar, π/sup -/, C, q) nor the collision energy for P/sub lab/ ≧ 22 GeV/c ((Sq root)S=W > 6 GeV). The obtained result means that the hadronization of the colour charges is determined by the dynamics of their interaction with vacuum. 17 refs.; 8 figs.; 3 tabs.

44084 (JINR-E—1-87-689) High statistics measurement of the proton structure function and tests of QCD from deep inelastic muon scattering at high Q/sup 2/. Benvenuti, A.C.; Bollini, D.; Bruni, G. and others. (Bologna Univ. (Italy). Ist. di Fisica). (Joint Inst. for Nuclear Research, Dubna (USSR)). 1987. 12p. NTIS (US Sales Only), PC A03/MF A01. Order Number DE88703677/JAW.

We present preliminary results on a high statistics measurement of the proton structure functions F/sub 2/(x, Q/sup 2/) and the ratio of absorption cross sections for virtual photons of longitudinal and transverse polarization R=σ/sub L//σ/sub T/ measured in deep inelastic scattering of muons of hydrogen are presented. The analysis is based on 2x10/sup 6/ events after all cuts recorded at beam energies of 100, 120, 200 and 280 GeV and covering a kinetamic range 0.06 ≦ x ≦ 0.80 and 7 GeV/sup 2/ ≦ Q/sup 2/ ≦ 260 GeV/sup 2/. Scaling violations which are observed in the data are compared to predictions of perturbative QCD. They allow to determine the QCD mass scale parameter Λ and to estimate the distribution of gluons in the proton. 19 refs.; 8 figs.; 3 tabs. submitted to the Intern. Europhys. Conf. on High Energy Physics, Uppsala, June 25 - July 1, 1987.

44085 (JINR-R—1-87-271) Differential cross section of the π/sup -/p -> etaΔ/sup 0/ (1232) reaction at 3,3 and 4.75 GeV/c momenta. Arkhipov, V.V.; Astvatsaturov, R.G.; Aslanyan, P.Zh. and others. (Joint Inst. for Nuclear Research, Dubna (USSR). Lab. of High Energy; Erevanskij Gosudarstvennyj Univ. (USSR)). (Joint Inst. for Nuclear Research, Dubna (USSR). Lab. of High Energy). 1987. 8p. (In Russian). NTIS (US Sales Only), PC A02/MF A01. Order Number DE88703712/JAW.

Submitted to the journal Sov. J.Nucl. Phys. .

The differential cross sections of the π/sup -/p -> etaΔ/sup 0/(1232) reaction at P/sub π/=3.3 and 4.75 GeV/c has been measured in the region of momentum transfers from t/sub min/ to 0.37 (GeV/c)/sup 2/. A significant minimum observed in the differential cross section indicates a dominance of the amplitude with helicity change. The experimental data have been fitted by the formula dδ/dt'=A(1-gCt)exp(Ct'), where g is the ratio of the spin-flip and spin-nonflip amplitudes. The effective Regge trajectory has been calculated for the π/sup -/p -> etaΔ/sup 0/(1232) reaction: a/sub eff/(t')=(0.49+-0.09)/sup +/(0.8+-0.5)t'. 13 refs.; 5 figs.; 3 tabs.

44086 (JINR-R—1-87-511) Λ/sub c//sup +/ baryon resonance production in neutrino interactions with nuclei in photoemulsion. Batusov, Yu.A.; Bunyatov, S.A.; Kuznetsov, O.M. and others. (Joint Inst. for Nuclear Research, Dubna (USSR)). (Joint Inst. for Nuclear Research, Dubna (USSR). Lab. of Nuclear Problems). 1987. 6p. (In Russian). NTIS (US Sales Only), PC A02/MF A01. Order Number DE88703715/JAW.

Submitted to the journal JETP Lett. .

It is shown that in neutrino interactions with nuclei in photoemulsion a considerable part ((0.58+0.17)-(0.58-0.22)) of charmed Λ/sup +/ baryons can be produced via decays of charmed Σ/sub c/ resonances. Three of four detected events with the production of Λ/sub c//sup +/ are interpreted as production and decay of charmed Σ/sub c//sup 0/(2450)-, Σ/sub c//sup ++/(2450)- and Σ/sup ++/(2510)-resonances via the Λ/sub c//sup +/π/sup +-/ channel. The average value of the mass differences Σ/sub c/(2450) and Λ/sub c//sup +/ equals 162 +- 2 MeV/c/sup 2/. 8 refs.; 1 fig.; 1 tab.

44087 (JINR-R—1-87-750) Determination of double pomeron exchange contribution to the cross section of p-barp->p-barpπ/sup +/π/sup -/ reaction at 22.4 GeV/c. Kanazirski, Ch.; Tikhonova, L.A. (Joint Inst. for Nuclear Research, Dubna (USSR). Lab. of High Energy). 1987. 5p. (In Russian). NTIS (US Sales Only), PC A02/MF A01. Order Number DE88703720/JAW.

An attempt of estimating double pomeron exchange (DPE) contribution to the p-barp -> p-barpπ/sup +/π/sup -/ reaction at 22.4 Gev/c is described. The reaction has been studied using "Ludmila" HBC. The main processes which do not permit to select definitely DPE in this reaction are single vertex diffraction of the incident particles and double isobar production. Then value of DPE cross section σ/sub DPE/=10+-6 μb should be considered only as an upper limit of double pomeron exchange. 17 refs.; 4 figs.

44088 (LA—11300-P) A proposal for a precision test of the standard model by neutrino-electron scattering (Large {hacek C}erenkov Detector Project). Allen, R.C.; Lu, X-Q.; Gollwitzer, K.; Igo, G.J.; Gulmez, E.; Whitten, C.; VanDalen, G.; Layter, J.; Fung, Sun Yui; Shen, B.C. (California Univ., Irvine (USA); California Univ., Los Angeles (USA); California Univ., Riverside (USA); Colorado Univ., Boulder (USA); Los Alamos National Lab., NM (USA); New Mexico Univ., Albuquerque (USA); Pennsylvania Univ., Philadelphia (USA); Temple Univ., Philadelphia, PA (USA); College of William and Mary, Williamsburg, VA (USA)). Apr 1988. Contract W-7405-ENG-36. 303p. NTIS, PC A14/MF A01;1; GPO Dep. Order Number DE88008516/JAW.

A precision measurement of neutrino-electron elastic scattering from a beam stop neutrino source at LAMPF is proposed. The total error in sin$^2\theta$/sub W/ is estimated to be +-0.89{percent}. The experiment also will be sensitive to neutrino oscillations and supernova-neutrino bursts, and should set improved limits on the neutrino-charge radius and magnetic-dipole moment. The detector consists of a 2.5-million-gallon tank of water with approximately 14,000 photomultiplier tubes lining the surfaces of the tank. Neutrino-electron scattering events will be observed from the {hacek C}erenkov radiation emitted by the electrons in the water. 19 refs.

44089 (SLAC-PUB—4609) Review of recent results on the {tau} lepton. Gan, K.K. (Stanford Linear Accelerator Center, Menlo Park, CA (USA)). Apr 1988. Contract AC03-76SF00515. 14p. (CONF-8803109—2). NTIS, PC A03/MF A01; 1; GPO Dep. Order Number DE88012565/JAW.

From 23. Rencontre de Moriond conference: electroweak interactions and unified theories; Les Arcs, France (6 Mar 1988).

This is a review of the recent results on the {tau} lepton. The results include precise measurements of the lifetime, measurements of the decay {tau}/sup {minus}/ → π/sup {minus}/2$\pi^0\nu$/sub {tau}/ with much improved precision, limits on decay modes containing {eta} mesons, including the second-class-current decay {tau}/sup {minus}/ → π/sup {minus}/{eta}ν/sub {tau}/, and limits on exotic decay modes. The implications of these results on the discrepancy in the one-charged-particle decay modes are discussed. 43 refs., 4 figs., 2 tabs.

44090 (SLAC-PUB—4637) Spin-spin correlations in proton-proton collisions at high energy and threshold enhancements. de Teramond, G.F. (Stanford Linear Accelerator Center, Menlo Park, CA (USA)). May 1988. Contract AC03-76SF00515. 6p. (CONF-8805142—5). NTIS, PC A02/MF A01; 1; GPO Dep. Order Number DE88012739/JAW.

From 3. conference on the intersections between particle and nuclear physics; Rockport, ME, USA (14 May 1988).

The striking effects in the spin structure observed in elastic proton collisions and the Nuclear Transparency phenomenon recently discovered at BNL are described in terms of heavy quark threshold enhancements. The deviations from scaling laws and the broadening of the angular distributions at resonance are also consistent with the introduction of new degrees of freedom in the pp system. This implies new s-channel physics. Predictions are given for the spin effects in pp collisions near 18.5 GeV/c at large p/sub T/^{2} where new measurements are planned. 9 refs., 4 figs.

44091 (SLAC-PUB—4651) J/{psi} results from Mark III. Mir, R. (Stanford Linear Accelerator Center, Menlo Park, CA (USA); Washington Univ., Seattle (USA)). Jun 1988. Contract AC03-76SF00515. 7p. (CONF-8804147—2; UWSEA—88-01). NTIS, PC A02. Order Number DE88012743/JAW.

From 8. international workshop on photon-photon collisions; Shoresh, Israel (24 Apr 1988).

Measurements of the two body decays of the J/{psi} into vector and pseudoscalar meson pairs are presented. Using the measured branching ratios, a phenomenological model of J/{psi} decays indicates that the {eta} and {eta}' are composed only of light and

strange quarks, without a gluonium contribution in the {eta}' wavefunction. A measurement of J/{psi} → γπ⁺π/sup {minus}/π⁺π/sup {minus}/ is presented. The f_1 (1285) is observed and its spin and parity are investigated. The {eta}/sub c/ is observed to decay to {rho}⁰{rho}⁰, and first indications of {eta}/sub c/ decays to f_2f_2 are presented. The spin and parity of the {eta}/sub c/ are investigated. 5 figs., 3 figs., 1 tab.

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REFER ALSO TO CITATION(S) 44004, 44010, 44011, 44012, 44075, 44089, 44188, 44189, 44263

44092 **(EFI—980(30)-87) Radiative and leptonic transitions of mesons in relativistic quark model.** Aznauryan, I.G.; Oganesyan, K.A. (Erevanskij Fizicheskij Inst. (USSR)). 1987. 24p. NTIS (US Sales Only), PC A03/MF A01. Order Number DE88703492/JAW.

A good description of available experimental data on radiative and leptonic decays, and also on electromagnetic radii for pseudoscalar, vector, axial and tensor mesons, is obtained. 32 refs.; 1 tab.

44093 **(IC—87/356) O(5) x U(1) electro weak gauge theory and the relevance of the Cabibbo angle in CP violation in K-decays.** Samiullah, M. (International Centre for Theoretical Physics, Trieste (Italy)). Nov 1987. 15p. NTIS (US Sales Only), PC A03/MF A01. Order Number DE88703517/JAW.

Some of the relevant mathematics of O(5)xU(1) electro weak gauge theory is briefly sketched. The O(5)xU(1) model is presented. To facilitate the discussion of CP-violation in K-decays the relevant Lagrangian is given in several alternative forms. It is shown that in the CP-violating part of the Lagrangian, by a redefinition of quark phases, the coupling of the CP eigenstates K/sub 1/ and K/sub 2/ cannot be broken. However, if the Cabibbo angle were not present, the states K/sub 1/ and K/sub 2/ would decouple and the theory would become CP-invariant. Such a result was also reported by Deshpande et al. working with a different formalism. Relating the mixing parameters θ and phi to the parameters ε/sub 1/ and ε/sub 2/ it is shown that when ε/sub 1/=ε/sub 2/=ε, ε reduces to the usual CP-violating and CPT conserving parameter. (author). 14 refs.

44094 **(IFVE-OTF—87-182) Canonical quantization and mass spectrum of relativistic particle-analog of relativistic string with rigidity.** Plyushchaj, M.S. (Gosudarstvennyj Komitet po Ispol'zovaniyu Atomnoj Ehnergii SSSR, Serpukhov. Inst. Fiziki Vysokikh Ehnergij). 1987. 11p. (In Russian). NTIS (US Sales Only), PC A03/MF A01. Order Number DE88703547/JAW.

Submitted to the journal Modern Phys. Lett. A.

The genralized model of relativistic particle is explored. Its action contains the term for free particle of mass m together with additional term proportional to the curvature of its trajectory. From the full set of Hamiltonian constraints the mass shell condition is chosen and canonical quantization of model is performed. It is shown that quantized system is equivalent to relativistic rotator with the mass spectrum coinciding with spectrum of squared Majorana equation M/sup 2/=m/sup 2//1+α/sup 2/s(s+1), where M is rotator's mass, s - its spin and α/sup -1/ is a constant in additional term in action. 12 refs.

44095 **(ITEF—31(1987)) Cherenkov radiation of an extended tachyon. 1. Radiation characteristics.** Perepelitsa, V.F. (Gosudarstvennyj Komitet po Ispol'zovaniyu Atomnoj Ehnergii SSSR, Moscow. Inst. Teoreticheskoj i Ehksperimental'noj Fiziki). 1987. 25p. (In Russian). NTIS (US Sales Only), PC A03/MF A01. Order Number DE88703591/JAW.

The problem of Cherenkov radiation induced by an extended charged tachyon is considered. Evaluations of Cherenkov energy loss, tachyon ranges and other expected experimental features of the radiation are given for various models of tachyon form factors. As follows from the consideration charged tachyon produced in any given process appears to be powerfull pointlike source of hard X and γ rays, possessing a charateristics angular distribution. A few experimental proposals of search for tachyons concerning both bubble chamber and electronic experiments are made. 14 refs.; 1 fig.

44096 **(ITEF—34(1987)) Cherenkov radiation of an extended tachyon. 2.Possible experiments to search for tachyons.** Perepelitsa, V.F. (Gosudarstvennyj Komitet po Ispol'zovaniyu Atomnoj Ehnergii SSSR, Moscow. Inst. Teoreticheskoj i Ehksperimental'noj Fiziki). 1987. 23p. (In Russian). NTIS (US Sales Only), PC A03/MF A01. Order Number DE88703592/JAW.

This paper is devoted to consideration of the problem on the Cherenkov radiation of extended charged tachyons. It contains suggestions to carry out experiments on search for such tachyons based on application of tachyon Cherenkov radiation features. If a charged tachyon is produced in any process, it manifests itself as a powerful and practically point source of hard X-ray and γ radiation with typical angular distribution. These properties of superlight particles, being of the brightly expressed "signature" character, can be the bases for the experiments on their search both by means of bubble chambers and electronic technique. 10 refs.; 3 figs.

44097 **(ITEP—17(1988)) On the possible existence of a long-lived strange dibaryon.** Kondratyuk, L.A.; Ral'chenko, Yu.V.; Vasilets, A.V. (Gosudarstvennyj Komitet po Ispol'zovaniyu Atomnoj Ehnergii SSSR, Moscow. Inst. Teoreticheskoj i Ehksperimental'noj Fiziki). 1988. 25p. NTIS (US Sales Only), PC A03/MF A01. Order Number DE88703613/JAW.

Using the QCD string model with spin-orbit coupling the masses of strange S=-1 dibaryons are calculated. Possible existence of a long-lived state DB/sub S//sup -/ (with the lifetime much larger than tau/sub Σ/) with the mass 2.03 GeV ≦ M ≦ M/sub Σ/+M/sub N/ and the isospin I=3/2 is predicted. The weak nonleptonic and semileptonic decay widths of DB/sub S//sup -/ and its production cross section in the reaction π/sup -/d -> K/sup +/DB/sub S//sup -/ are calculated. The results are compared with the available experimental data. 37 refs.; 6 figs.

44098 **(ITEP—103(1987)) Multiquark masses and wave functions through modified Green's function Monte Carlo method.** Kerbikov, B.O.; Polikarpov, M.I.; Shevchenko, L.V. (Gosudarstvennyj Komitet po Ispol'zovaniyu Atomnoj Ehnergii SSSR, Moscow. Inst. Teoreticheskoj i Ehksperimental'noj Fiziki). 1987. 23p. NTIS (US Sales Only), PC A03/MF A01. Order Number DE88703614/JAW.

The Modified Green's function Monte Carlo method (MGFMC) is used to calculate the masses and ground-state wave functions of multiquark systems in the potential model. The previously developed MGFMC is generalized in order to treat systems containing quarks with inequal masses. The obtained results are presented with the Cornell potential for the masses and the wave functions of light and heavy flavoured baryons and multiquark states (N=6, 9, 12) made of light quarks. 21 refs.; 1 fig.; 2 tabs.

44099 **(ITEP—149(1987)) Effective Lagrangian from anomalies of QCD.** Belyaev, V.M.; Ksenzov, V.G. (Gosudarstvennyj Komitet po Ispol'zovaniyu Atomnoj Ehnergii SSSR, Moscow. Inst. Teoreticheskoj i Ehksperimental'noj Fiziki). 1987. 11p. NTIS (US Sales Only), PC A03/MF A01. Order Number DE88703616/JAW.

The effective lagrangians reproducing dilaton and axial anomalies of QCD are constructed. Different methods of lagrangian construction are discussed. The lagrangians are formulated in terms of two particles with J/sup P/=0/sup +/ and 0/sup -/. It is supposed that the state 0/sup -/ is SU(3) singlet meson eta. The dilaton mass and width are estimated. 16 refs.

44100 (ITEP—162(1987)) Spin structure of binary processes in the /sup 3/P/sub 0/ model of coloured tube. Levintov, I.I. (Gosudarstvennyj Komitet po Ispol'zovaniyu Atomnoj Ehnergii SSSR, Moscow. Inst. Teoreticheskoj i Ehksperimental'noj Fiziki). 1987. 24p. NTIS (US Sales Only), PC A03/MF A01. Order Number DE88703618/JAW.

The binary processes 0+1/2 ->0+1/2 (π/sup -/p -> π/sup 0/n, π/sup -/p -> etan) are considered in the coloured tube model. It is shown that the relations of residues of the amplitude M/sub 0/ +iσ-vectorn-vectorq/2q/sub 0/M/sub 1/ and their q/sup 2/-dependence at the secondary Regge pole exchange is determined by the wave function of a gg-bar pair which appears in the /sup 3/P/sub 0/ state at disruption of a coloured tube. The account of the Thomas interaction gives a small contribution into matrix elements logarithmically decreasing with energy. The model, accounting for absorption, agrees semiquantitatively with experimental data. 18 refs.; 4 figs.

44101 (ITEP—205(1987)) On the role of the tadpole transition <O/H/sup weak//K/sub s/(o)> in the K/sub s/->2π decays. Shabalin, E.P. (Gosudarstvennyj Komitet po Ispol'zovaniyu Atomnoj Ehnergii SSSR, Moscow. Inst. Teoreticheskoj i Ehksperimental'noj Fiziki). 1987. 8p. NTIS (US Sales Only), PC A02/MF A01. Order Number DE88703627/JAW.

Being taken into account, the tadpole part of amplitude restores chiral properties of K(p/sub k/) -> π+π amplitude calculated in the vacuum insertion method because it ensures replacing the momentum-independent part of such an amplitude by the term (2F/sub π/F/sub k/)/sup -1/<0/H/sup weak//K/sub s/(0)>p/sub k//sup 2//m/sub k//sup 2/. As a consequence, a part of the total on-shell amplitude may be expressed directly in terms of the <0/H/sup weak//K/sub s/(0)> amplitude. 13 refs.; 2 figs.

44102 (ITEP—215(1987)) On compatibility of small mass with large magnetic moment of neutrino. Voloshin, M.B. (Gosudarstvennyj Komitet po Ispol'zovaniyu Atomnoj Ehnergii SSSR, Moscow. Inst. Teoreticheskoj i Ehksperimental'noj Fiziki). 1987. 16p. NTIS (US Sales Only), PC A03/MF A01. Order Number DE88703629/JAW.

The problem is considered of natural compatibility of small neutrino mass <or approx. 30 eV with a hypothetical neutrino magnetic moment 10/sup -10/-10/sup -10/ of the Bohr magneton which is suggested for explanation of possible modulation of the solar neutrino flux. It is argued that suppression of the neutrino mass with finite magnetic moment can be a consequence of SU(2) symmetry between neutrino and antineutrino. A model is discussed with SU(4) symmetry in the lepton electroweak sector in which the neutrino magnetic moment arises via charged scalars belonging to SU(4) sextet, and the neutrino mass is generated only at the two-loop level through electroweak radiative corrections. To naturally keep the neutrino mass in the range 10-30 eV the masses of the charged scalars should be of order few tens of GeV. Thus, it makes sense to look for these scalar particles at new e/sup +/e/sup -/ colliders. 13 refs.; 3 figs.

44103 (JINR-E—1,2-87-567) Neutrinos today. Pontecorvo, B.; Bilen'kij, S. (Joint Inst. for Nuclear Research, Dubna (USSR). Lab. of Nuclear Problems; Joint Inst. for Nuclear Research, Dubna (USSR). Lab. of Theoretical Physics). 1987. 56p. NTIS (US Sales Only), PC A04/MF A01. Order Number DE88703674/JAW.

Submitted to the Annuario Enciclopedia Scienza e Tecnica, Mondadori 1987, Italy.

After the famous 1983 discovery of intermediate W, Z/sup 0/ bosons it may be stated with certainty that W, Z/sup 0/ are entirely responsible for the production of neutrinos and for their interactions. Neutrino physics notions are presented from this point of view in the first four introductory, quite elementary, paragraphs of the paper. The following seven paragraphs are more sophisticated. They are devoted to the neutrino mass and neutrino mixing question, which is the most actual problem in today neutrino physics. Vacuum neutrino oscillations, matter neutrino oscillations and netrinoless double-decay are considered. Solar neutrino physics is discussed in some detail from the point of view of vacuum and matter neutrino oscillations. The role played by neutrinos in the Universe is briefly considered. In the last paragraph there discussed the probable observation by different groups of neutrinos connected with the Supernova 1987 A: the first observation of gravitational star collapse (at least the general rehearsal of such observation) opens up a new era in astronomy of today exerimental physics and astrophysics is presented at the end of the paper in the form of a Table. 12 refs.; 9 figs.

44104 (JINR-E—1-87-699) Test of QCD and a measurement of Λ from scaling violations in the nucleon structure function F/sub 2/(x,Q/sup 2/) at high Q/sup 2/. Benvenuti, A.C.; Bollini, D.; Bruni, G. and others. (Bologna Univ. (Italy). Ist. di Fisica). (Joint Inst. for Nuclear Research, Dubna (USSR)). 1987. 7p. NTIS (US Sales Only), PC A02/MF A01. Order Number DE88703678/JAW.

Submitted to the journal Phys. Lett., B.

Scaling violations in the nucleon structure function F/sub 2/(x, Q/sup 2/) measured with high statistics in deep inelastic scattering of muons on a carbon target are compared to predictions of perturbative QCD. Excellent agreement is observed with numerical solutions of the Altarelli-Parisi evolution equations over entire x and Q/sup 2/ range of the data. In a next-to-leading order nonsinglet approximation, the QCD mass scale parameter Λ/sub MS/ is determined to be 230 +- 20 (stat.) +- 60 (syst.) MeV. A singlet fit to the data favours a soft gluon distribution. 15 refs.; 3 figs.; 1 tab.

44105 (JINR-E—2-87-69) Low-energy theorems for gravitino-scalar particle scattering. Chavleishvili, M.P. (Tbilisskij Gosudarstvennyj Univ. (USSR)). (Joint Inst. for Nuclear Research, Dubna (USSR). Lab. of Theoretical Physics). 1987. 6p. NTIS (US Sales Only), PC A02/MF A01. Order Number DE88703680/JAW.

Submitted to the journal Phys. Lett., B.

The kinematic structure of the helicity amplitudes of massless gravitino scattering on scalar particle is investigated. Dynamic amplitudes which are of the same dimension and free from kinematic singularities are introduced. Dispersion relations and low-energy theorems for helicity amplitudes are obtained. 12 refs.

44106 (JINR-E—2-87-595) Study of electroweak radiative corrections to deep inelastic scattering at HERA. Bardin, D.Yu.; Burdik, C.; Christova, P.Ch.; Riemann, T. (Joint Inst. for Nuclear Research, Dubna (USSR). Lab. of Theoretical Physics). 1987. 18p. NTIS (US Sales Only), PC A03/MF A01. Order Number DE88703682/JAW.

Submitted to the Workshop on Physics at HERA, Hamburg, 12-14 Oct. 1987.

Results of a careful recalculation of electroweak radiative corrections to neutral and charged current deep inelastic ep-scattering at HERA energies are presented. Numerical results are based on the newly developed Fortran code DISEP. 21 refs.; 7 figs.

44107 (JINR-E—2-87-599) Non-relativistic model of two-particle decay. Relation to the scattering theory, spectral concentration and bound states. Dittrich, J.; Exner, P. (Joint Inst. for Nuclear Research, Dubna (USSR). Lab. of Theoretical Physics). 1987. 20p. NTIS (US Sales Only), PC A03/MF A01. Order Number DE88703683/JAW.

The present paper, which represents the fourth part of the series devoted to analysis of a simple Lee-type model of two-particle decay, deals with three problems. The first one concerns relation of the model to the scattering theory. The asymptotic completeness for elastic scattering of the two light particles is proved and it is shown that for sufficiently weak coupling this system has just one resonance, which position is the same as that of the pole, which yields the main contribution to the decay law. The second problem concerns spectral concentration; its occurrence for families of intervals around E that shrink slower than quadratically in g is proved. Finally, necessary and sufficient conditions for. 7 refs.

44108 **(JINR-E—2-87-630) Nonleptonic decays of K-mesons.** Avakyan, E.Z.; Avakyan, S.L.; Efimov, G.V.; Ivanov, M.A. (Tashkentskij Gosudarstvennyj Univ. (USSR)). (Joint Inst. for Nuclear Research, Dubna (USSR). Lab. of Theoretical Physics). 1987. 24p. NTIS (US Sales Only), PC A03/MF A01. Order Number DE88703684/JAW.

Submitted to the journal Sov. J. Nucl. Phys. .

Leptonic, semileptonic, nonleptonic and electromagnetic decays of K-mesons are treated in the framework of quark confinement model. Effective Hamiltonian of weak interactions is used for description of nonleptonic decays of kaons. Widths of nonleptonic and electromagnetic kaonic decays, slope parameters for semileptonic decays and electromagnetic radii of kaons are calculated. 27 refs.; 3 figs.; 6 tabs.

44109 **(JINR-E—4-87-297) Off-shell effects in the coherent π/sup 0/ photoproduction off nuclei.** Chumbalov, A.A.; Kamalov, S.S. (Kazakhskij Gosudarstvennyj Univ., Alma-Ata (USSR)). (Joint Inst. for Nuclear Research, Dubna (USSR). Lab. of Theoretical Physics). 1987. 11p. NTIS (US Sales Only), PC A03/MF A01. Order Number DE88703689/JAW.

Submitted to the journal Phys. Lett., B.

A strong sensitivity of coherent π/sup 0/-meson photoproduction on nuclei to different ω reaction energy change in elementary amplitude t/sub $\pi\gamma$/ (ω) is demonstrated. Various assumptions concerning ω behaviour in the extraenergy area can change differential cross sections 1.5-2 times. The best agreement of the DWIA-results with experimental data is obtained at ω being equal to its own value of pion-nucleon system free relativistic Hamiltonian. Such a result agrees with relativistic potential theory effects. 13 refs.; 4 figs.

44110 **(JINR-R—2-87-660) On longitudinal dimensions of relativistic particles.** Strel'tsov, V.N. (Joint Inst. for Nuclear Research, Dubna (USSR). Lab. of High Energy). 1987. 11p. (In Russian). NTIS (US Sales Only), PC A03/MF A01. Order Number DE88703730/JAW.

Special features are discussed of using for description of neutral particles with spin 1/2 (within the Majorana representation) of real bispinor wave functions, in particular, a known difficulty: 4 - vector probability current of j/sup k/- "light" vector. Introduction of quarter-spinors permits to construct formally a time-like 4-vector j/sup k/. Tensor of spin density properties and of proper Lorentz moment, proper wave function of projection operator of Lorentz moment etc. are considered. 7 refs.

44111 **(JINR-R—2-87-674) Quantum chromostatics as low-energy hadron theory.** Pervushin, V.N.; Kallies, W.; Nguyen Suan Han; Sarikov, N.A. (Joint Inst. for Nuclear Research, Dubna (USSR). Lab. of Theoretical Physics; AN Uzbekskoj SSR, Tashkent. Inst. Yadernoj Fiziki). (Joint Inst. for Nuclear Research, Dubna (USSR). Lab. of Theoretical Physics). 1987. 30p. (In Russian). NTIS (US Sales Only), PC A03/MF A01. Order Number DE88703731/JAW.

Submitted to the Intern. J. of Modern Phys. A and to the Organizing Comittee of 8. International Conference on quantum field theory problems.

The low-energy approximation of QCD, the quantum chromostatics (QCS) with infrared redefinition of the Coulomb potential, is proposed. The perturbation theory in QCD is formulated as a low-energy expansion on the spatial-components of gluon fields (by analogy with QED) over the nonperturbative background defined by QCS. It is shown that in the framework of QCS one can describe the spectroscopy of light and heavy quarkonia, the low-energy hadron physics with spontaneous chiral symmetry breaking and confinement. The chromostatics for gluons leads to spontaneous generation of a gluon mass and, as a result, to infrared modification of the asymptotical freedom formula. Such a modification substances smallness of the effective coupling constant and applicability of the perturbation theory in the region of a small transfer momentum. 29 refs.

44112 **(JINR-R—2-87-776) Strong form factors of the nucleon and Δ isobars in the quark confinement model.** Efimov, G.V.; Ivanov, M.A.; Lyubovitskij, V.E. (Joint Inst. for Nuclear Research, Dubna (USSR). Lab. of Theoretical Physics; Tomskij Gosudarstvennyj Univ. (USSR)). (Joint Inst. for Nuclear Research, Dubna (USSR). Lab. of Theoretical Physics). 1987. 19p. (In Russian). NTIS (US Sales Only), PC A03/MF A01. Order Number DE88703737/JAW.

Submitted to the journal Few Body.

The nucleon and Δ isobar are investigated as three-quark systems in the quark confinement model based on definite assumptions about the hadronization and quark confinement. The nucleon magnetic electromagnetic radii, the ratio G/sub A//C/sub V/ in neutron beta decay and the width decay of Δ -> pπ are calculated. The behaviour of the electromagnetic and strong meson-nucleon isobar form factors is determined for the space-like transfer momenta. The results are compared with the experimental data for the electromagnetic form factors and the phenomenological ones used in the Bonn potential for the strong form factors. 23 refs.; 5 figs.; 2 tabs.

44113 (KEK—87-20, pp 6-13) **B^0-B-bar^0 mixings and the standard theory.** Tanimoto, Morimitsu. (Ehime Univ., Matsuyama (Japan)). Nov 1987. NTIS (US Sales Only), PC A12/MF A01. Order Number DE88780084/JAW. (CONF-8705290—).

From Meeting on physics at TeV energy scale; Oho, Japan (28 May 1987).

We study the B/sub d(s)/^{0} -B-bar/sub d(s)/^{0} mixing in the KM standard theory by use of the formula insensitive to the ambiguous parameters, and compare the theoretical prediction with the experimental results by ARGUS, UA1, CLEO and MARK II. We find that these experimental bounds endanger the KM standard theory with three generations although these bounds do not exclude it completely. It is remarked that the four generation scheme is well consistent with the experimental data.

44114 (KEK—87-20, pp 14-19) **Cross section formulae on single W and Z boson productions in electron-positron collisions.** Katuya, Mituaki. (Shizuoka Univ. (Japan)). Nov 1987. NTIS (US Sales Only), PC A12/MF A01. Order Number DE88780084/JAW. (CONF-8705290—).

From Meeting on physics at TeV energy scale; Oho, Japan (28 May 1987).

The formulae are given for the transverse momentum distributions and total cross sections for the single W boson and Z boson productions in electron-positron collisions by using the equivalent photon approximation.

44115 (KEK—87-20, pp 20-25) **On the equivalence theorem between W/sub L/, Z/sub L/ and Nambu-Goldstone particles.** Aoki, Ken-ichi. (Kyoto Univ. (Japan). Research Inst. for Fundamental Physics). Nov 1987. NTIS (US Sales Only), PC A12/MF A01. Order Number DE88780084/JAW. (CONF-8705290—).

From Meeting on physics at TeV energy scale; Oho, Japan (28 May 1987).

The equivalence theorem is reviewed, with its physical understanding and a simple proof by using the operator formalism of the spontaneously broken gauge theory. The equivalence relation is due to the unitarity requirement of non-production of the Nambu-Goldstone particles in any physical scattering processes. Contrary to the previous arguments, there are in general $O(g^2)$ corrections to the equivalence relation.

44116 (KEK—87-20, pp 32-42) **Slepton search at hadron colliders.** Hidaka, K.; Kogai, H. (Tokyo Gakugei Univ., Koganei (Japan). Dept. of Physics). Nov 1987. NTIS (US Sales Only), PC A12/MF A01. Order Number DE88780084/JAW. (CONF-8705290—).

From Meeting on physics at TeV energy scale; Oho, Japan (28 May 1987).

We compute cross sections for slepton pair production in / sup (/p-bar/sup)/p collisions at TEVATRON and SSC. We find that a detectable number of sleptons should be produced at TEVA-

TRON and SSC if their masses are less than ~ 100 GeV and ~ 1.0 TeV, respectively, and that this process deserves detailed Monte Carlo studies to separate signal events from backgrounds.

44117 (KEK—87-20, pp 43-49) **Polarization effects for slepton production in e^+e^- collisions.** Jimbo, Masato; Kon, Tadashi. (Rikkyo Univ., Tokyo (Japan). Dept. of Physics). Nov 1987. NTIS (US Sales Only), PC A12/MF A01. Order Number DE88780084/JAW. (CONF-8705290—).

From Meeting on physics at TeV energy scale; Oho, Japan (28 May 1987).

We investigate the single slepton production associated with photino (e^+e^- -> $1^+\gamma$ tilde l tilde/sub R/$^-$ and e^+e^- -> $1^+\gamma$ tilde l tilde/sub L/$^-$) in longitudinally polarized e^+e^- beams. It is shown that the information on the low-energy mass spectrum of supersymmetric particles would be obtained by the polarized cross sections.

44118 (KEK—87-20, pp 50-58) **Wino pair production in e^+e^- annihilation.** Kizukuri, Y.; Oshimo, N. (Tokai Univ., Hiratsuka, Kanagawa (Japan). Dept. of Physics). Nov 1987. NTIS (US Sales Only), PC A12/MF A01. Order Number DE88780084/JAW. (CONF-8705290—).

From Meeting on physics at TeV energy scale; Oho, Japan (28 May 1987).

Phenomenological predictions on wino pair production in e^+e^- annihilation and subsequent leptonic decay of the wino are studied. The energy distribution, angular distribution and forward-backward asymmetry of a charged lepton in the final state are discussed with various sets of parameters, and compared with those in the heavy lepton pair production and its subsequent decay process. The ratio of the leptonic and hadronic decay widths of the wino is shown to be a useful quantity for the identification of the wino. A T-violation phenomenon in Z' -> w/sub h/$^+$ w/sub l/$^-$ is also discussed.

44119 (KEK—87-20, pp 59-73) **Low energy physics from superstring.** Matsuoka, Takeo. (Nagoya Univ. (Japan). Dept. of Physics). Nov 1987. NTIS (US Sales Only), PC A12/MF A01. Order Number DE88780084/JAW. (CONF-8705290—).

From Meeting on physics at TeV energy scale; Oho, Japan (28 May 1987).

Realistic models from the ten-dimensional $E_8 \times E_8'$ superstring theory are reviewed, which satisfy the constraints coming from the longevity of the proton, the quark mass generation and zero or small masses of neutrinos. The discrete symmetries linked to the topology of the Calabi-Yau compacified manifold are also discussed.

44120 (KEK—87-20, pp 97-105) **Neutrino masses in the superstring inspired models.** Doi, M.; Kotani, T.; Kurimoto, T.; Nishiura, H.; Takasugi, E. (Osaka Coll. of Pharmacy, Matsubara (Japan)). Nov 1987. NTIS (US Sales Only), PC A12/MF A01. Order Number DE88780084/JAW. (CONF-8705290—).

From Meeting on physics at TeV energy scale; Oho, Japan (28 May 1987).

In the framework of the superstring inspired models, neutrino masses are examined in the multi-generation cases. Mass patterns of neutrinos have been worked out in the minimum models. It has been shown by using the extended see-saw mechanism that at least one of neutrinos has relatively larger mass than those predicted in the ordinary GUTs.

44121 (KEK—87-20, pp 117-121) **Dimensional reduction regularization in the calculation of cross sections.** Sakakibara, Susumu. (Iwaki Meisei Univ., Fukushima (Japan). College of Science and Engineering). Nov 1987. NTIS (US Sales Only), PC A12/MF A01. Order Number DE88780084/JAW. (CONF-8705290—).

From Meeting on physics at TeV energy scale; Oho, Japan (28 May 1987).

We demonstrate the applicability of dimensional reduction regularization in the calculation of higher order QCD cross sections. Renormalized amplitudes can be obtained when UV poles are properly subtracted. The cross section thus obtained is the same as that in the usual dimensional regularization, when the relation between the two renormalization schemes is taken into account.

44122 (KEK—87-20, pp 122-130) **Nonstandard self-interactions of the weak vector bosons.** Kuroda, M. (Meiji Gakuin Univ., Yokohama, Kanagawa (Japan). Dept. of Physics). Nov 1987. NTIS (US Sales Only), PC A12/MF A01. Order Number DE88780084/JAW. (CONF-8705290—).

From Meeting on physics at TeV energy scale; Oho, Japan (28 May 1987).

Models of electroweak interactions are considered which are alternatives to the standard model and are consistent with the presently known experimental data. Tests of the models in the TeV energy region are discussed.

44123 (KEK—87-20, pp 148-153) **Supersymmetric quantum chromodynamics for composite quarks and leptons.** Yasue, Masaki. (Tokyo Univ., Tanashi (Japan). Inst. for Nuclear Study). Nov 1987. NTIS (US Sales Only), PC A12/MF A01. Order Number DE88780084/JAW. (CONF-8705290—).

From Meeting on physics at TeV energy scale; Oho, Japan (28 May 1987).

Quarks and leptons are regarded as composites generated by supersymmetric quantum chromodynamics (SQCD) with N-"colors" < M-"flavors", where the confinement scale Λ/sub sc/ is set to be ~ 1 TeV. There are three types of models that contain quarks and leptons together with other exotics as quasi Nambu-Goldstone fermions and chiral fermions. Their masses are calculated by using an effective lagrangian with the SUSY-breaking gluino- and scalar-masses (~ M/sub SS/) and controlled by the scale M/sub SS/(M/sub SS/Λ/sub sc/)/sup (M-N)/2(sub K (M/sub SS/ << Λ/sub sc/), where 2/sub K/ ≦ M-N is imposed by the anomaly-matching.

44124 (KEK—87-20, pp 160-170) **Solar neutrino problem v.s. laboratory neutrino oscillation experiments.** Lim, Chong-Sa. (Tokyo Univ., Tanashi (Japan). Inst. for Nuclear Study). Nov 1987. NTIS (US Sales Only), PC A12/MF A01. Order Number DE88780084/JAW. (CONF-8705290—).

From Meeting on physics at TeV energy scale; Oho, Japan (28 May 1987).

The present status of solar neutrino problem is briefly summarized first, from particle physics point of view. It is subsequently shown that a reduction formula, which is valid for arbitrary generation mixings, enables us to reduce the solar neutrino problem in 3 generation model to the one in an effective 2 generation system. We will also see how the observed solar neutrino depletion, together with data in a reactor experiment almost exclude a range of neutrino masses.

44125 (KEK—87-20, pp 171-176) **Solar and supernova neutrinos and the MSW effect.** Minakata, H.; Nunokawa, H.; Shiraishi, K.; Suzuki, H. (Tokyo Metropolitan Univ. (Japan). Dept. of Physics). Nov 1987. NTIS (US Sales Only), PC A12/MF A01. Order Number DE88780084/JAW. (CONF-8705290—).

From Meeting on physics at TeV energy scale; Oho, Japan (28 May 1987).

It has been shown that by taking the effect of the Earth into account the possible observation of prompt ν/sub e/ from SN1987A at Kamiokande II is compatible with the solution of the solar neutrino puzzle by the MSW mechanism. Our scenario requires relatively large mixing angles $\sin^2 2\theta >$ approx 0.3 and, most probably, Δm^2 of the order of $10^{-6} \sim 10^{-5}$ $(eV)^2$. In this talk we give more detailed discussions on the effects of the Earth to the solar neutrinos.

44126 (KEK—87-20, pp 186-193) **Exotic events.** Takasugi, Eiichi. (Osaka Univ., Toyonaka (Japan). Coll. of General Education). Nov 1987. NTIS (US Sales Only), PC A12/MF A01. Order Number DE88780084/JAW. (CONF-8705290—).

From Meeting on physics at TeV energy scale; Oho, Japan (28 May 1987).

In this note, I will discuss about two topics: One is the Majoron emitting $\beta\beta$ decay. The existence of this mode implies that at least the electron neutrino is a massive Majorana neutrino. The other is the tau$^-$ -> π^- etaν decay, which implies the existence of

the 2nd class current, probably the scalar current mediated by the charged Higgs bosons. The finding of these events suggests directly the necessesity of the standard model of electroweak interaction. Therefore, the attention should be paied for these exotic events.

44127 (KEK—87-20, pp 194-202) **Rare kaon decay search.** Inagaki, T. (National Lab. for High Energy Physics, Oho, Ibaraki (Japan)). Nov 1987. NTIS (US Sales Only), PC A12/MF A01. Order Number DE88780084/JAW. (CONF-8705290—).

From Meeting on physics at TeV energy scale; Oho, Japan (28 May 1987).

The rate decay experiments have provided useful information to the current physics. Two experimental plans for the rate K decay search are discussed here. The one is an experiment to search for the process of K/sub L/ -> μe which will start in this fall at KEK. The other is an experimental scope for the measurement of $K^+ \rightarrow \pi^+ \nu\bar{\nu}$. The experiment of this process in a branching ratio of 10^{-11} order will be done in the upgrade 12 GeV PS at KEK.

44128 (KEK—87-20, pp 203-215) **Recent developments in the search for the fifth force.** Fujii, Yasunori. (Tokyo Univ. (Japan). Inst. of Physics). Nov 1987. NTIS (US Sales Only), PC A12/MF A01. Order Number DE88780084/JAW. (CONF-8705290—).

From Meeting on physics at TeV energy scale; Oho, Japan (28 May 1987).

Two recent experiments searching for a composition-dependent force are briefly explained. To have a consistent understanding of these and other experiments an attempt is made by allowing a coupling of the force to the lepton number as well.

44129 (KEK—87-23, pp 221-233) **Explicit parametrizations of degenerate surfaces from KP equation and closed bosonic string amplitudes.** Kitazawa, Y. (Rockefeller Univ., New York (USA). Dept. of Physics). Dec 1987. NTIS (US Sales Only), PC A13/MF A01. Order Number DE88780085/JAW. (CONF-8706301—).

From Workshop on superstring theory; Oho, Japan (9 Jun 1987).

The p-loop amplitude of closed bosonic string theory involves the integration over the moduli space. We seek an explicit parametrization of Riemann matrices in terms of 3p-3 complex variables by solving the KP equation. We find explicit solutions of this problem (Schottky problem) for certain type of degenerate surfaces. For these classes of surfaces, we obtain closed bosonic string amplitudes from the Belavin-Knizhnik theorem using our parametrizations. We show in what precise way they are related to the correlation functions on the Riemann surfaces.

44130 (KEK—87-23, pp 250-283) **Equivalence of Polyakov and Witten bosonic string theory.** Ogura, Waichi. (Osaka Univ., Toyonaka (Japan). Dept. of Physics). Dec 1987. NTIS (US Sales Only), PC A13/MF A01. Order Number DE88780085/JAW. (CONF-8706301—).

From Workshop on superstring theory; Oho, Japan (9 Jun 1987).

It is shown that Polyakov string theory and the Witten's open bosonic string field theory give the same vacuum amplitudes with correct combinatorial factors in arbitrary order of perturbation expansion. The proof is based on the fact that the order of mapping class group and combinatorial factor of string Feynman diagram are equal.

44131 (NIKHEF-H—87-11) **Panti p -> W/sup +-/γX as a test of the quark charges.** Godbole, R.M.; Smith, J.; Neerven, W.L. van; Vermaseren, J.A.M. (Nationaal Inst. voor Kernfysica en Hoge-Energiefysica (NIKHEF), Amsterdam (Netherlands). Sectie H). 1987. 8p. (ITP-SB—87-28; DO-TM—87/5). NTIS (US Sales Only), PC A02/MF A01. Order Number DE88701775/JAW.

The recent suggestion that radiation zeroes can be used to test the difference between fractional and integer-charged quarks is examined. Since the amplitude zeroes for fractionally-charged quarks are altered by the effect of higher order QCD corrections it is found that the test is likely to be difficult. 6 refs.; 1 figure.

44132 **Linear response and plasmon decay in hot gluonic matter.** Nadkarni, S. (Center for Computational Sciences and Department of Physics and Astronomy, University of Kentucky, Lexington, Kentucky 40506-0055). *Physical Review Letters;* **61**: No. 4, 396-399(25 Jul 1988).

The current controversy over the damping of color oscillations in a quark-gluon plasma is resolved through a gauge-invariant linear-response analysis of relevant physical processes. The plasmon decay rate is shown to be γ = -11N/sub c/g^2T/24π to lowest perturbative order, but this result does not survive at higher orders. A self-consistent estimate suggests that plasmon decay is in fact a non-perturbative phenomenon governed by static screening effects.

44133 **Hadron structure of high-energy photons.** Drees, M.; Halzen, F. (Physics Department, University of Wisconsin, Madison, Wisconsin 53706). *Physical Review Letters;* **61**: No. 3, 275-277(18 Jul 1988).

We identify a new class of potentially large inclusive cross sections for the production of hadrons when high-energy photons interact with protons. Their origin is the abundant gluon content of very-high-energy photons. They can enhance the hadron (and also muon) content of high-energy electromagnetic showers as indicated by cosmic-ray observations and most dramatically illustrated by our failure to understand the muon content of photon showers from point sources. Experiments at the DESY ep collider HERA are in an ideal position to identify these contributions to photoproduction.

44134 **Landau-Zener approximations for resonant neutrino oscillations.** Whisnant, K. (Physics Department, Florida State University, Tallahassee, Florida 32306). *Physical Review* [*Section*] *D: Particles and Fields;* **38**: No. 2, 692-693(15 Jul 1988).

A simple method for calculating the effects of resonant neutrino oscillations using Landau-Zener approximations is presented. For any given set of oscillation parameters, the method is to use the Landau-Zener approximation which works best in that region.

44135 **Involution-dependent constants and the cancellation of divergences in the one-loop open-string amplitude.** Nagao, G. (Center for Particle Theory, Physics Department, The University of Texas, Austin, Texas 78712). *Physical Review* [*Section*] *D: Particles and Fields;* **38**: No. 2, 569-577(15 Jul 1988).

We recalculate the bosonic one-loop open-string scattering amplitude using the results of the bosonic one-loop closed-string amplitude. The results show explicitly how the cancellation of divergences depends upon a set of involution-dependent constants which relate the torus to the cylinder and Moebius strip. Such a set of involution-dependent constants exists at each loop level and thus provides a means with which to study the cancellation of divergences and the connection between the world sheet and internal symmetries.

44136 **Improved estimates for processes $b \rightarrow s l^+ l^-$, $B \rightarrow K l^+ l^-$, and $B \rightarrow K l^+ l^-$.** Deshpande, N.G.; Trampetic, J. (Institute of Theoretical Science, University of Oregon, Eugene, Oregon 97403-5203). *Physical Review Letters;* **60**: No. 25, 2583-2586(20 Jun 1988).

We present the complete calculation for the short-distance flavor-changing process $b \rightarrow s l^+ l^-$ and discuss the effect of QCD enhancement, and the resulting e-μ rate difference. We estimate the exclusive rates for $B \rightarrow K l^+ l^-$ and B→K/sup */$l^+ l^-$ using the relativistic constituent-quark model to calculate the different form factors that include recoil effects. The effect of the fourth generation in enhancing the rates is also discussed.

44137 **Muon production using colliding beams.** Chapline, G.F. (Lawrence Livermore National Lab., Livermore, CA (US)). pp 15 of Contributions to the muon catalyzed fusion workshop. Idaho Falls, ID; Idaho National Engineering Lab. (1985). (CONF-840660—).

From Workshop on muon-catalyzed fusion reactions; Jackson, WY, USA (7 Jun 1984).

The economics of fusion-fission breeders will probably require Q > 3, which implies that the muons required for fusion ca-

talysis must be produced using colliding beams rather than fixed targets. The authors describe a scheme for muon production using two intersecting storage rings for triton beams. Because of space charge limitations the production of useful numbers of muons will require storage rings with rather large but attainable emittances. It is shown that the storage rings can be filled in a manner consistent with Liouville's theorem using currently available ion sources. An alternate scheme involving injection of tritons into an imploding magnetic mirror system is also discussed.

6453 Particle Invariance Principles And Symmetries

REFER ALSO TO CITATION(S) 44149, 44153, 44154, 44182, 44185, 44189, 44192, 44193, 44195

44138 **(CBPF-NF—047/87) Using reduce in supersymmetry.** Santos, R.P. dos. (Centro Brasileiro de Pesquisas Fisicas, Rio de Janeiro). 1987. 8p. NTIS (US Sales Only), PC A02/MF A01. Order Number DE88702497/JAW.

A procedure which allows one to do Supersymmetry calculus in REDUCE is described. Using the concept of an eight-dimensional 'superspace' (spanned by four space-time and four anticommuting coordinates) and of 'superfields' (which represent an entire supermultiplet of particles that transform among themselves), covariant derivatives with respect to supersymmetry are defined. Then, combining the vector facility and LET statement in REDUCE, spinors are simulated in a way to control the algebraic manipulation. (G.D.F.).

44139 **(IC—87/399) Operator ordering and supersymmetry (an old problem becomes new).** De Alfaro, V.; Fubini, S.; Roncadelli, M.; Furlan, G. (Istituto Nazionale di Fisica Nucleare, Turin (Italy); European Organization for Nuclear Research, Geneva (Switzerland); Istituto Nazionale di Fisica Nucleare, Trieste (Italy)). (International Centre for Theoretical Physics, Trieste (Italy)). Nov 1987. 11p. NTIS (US Sales Only), PC A03/MF A01. Order Number DE88703524/JAW.

Supersymmetric quantum mechanics in curved space is investigated. The role of supersymmetry and of invariance under general coordinate transformation in solving the operator ordering ambiguity is discussed. 8 refs.

44140 **(INS—665) Monopoles with compactified extra dimensions.** Tomiya, Mitsuyoshi. (Tokyo Univ., Tanashi (Japan). Inst. for Nuclear Study). Dec 1987. 11p. NTIS (US Sales Only), PC A03/MF A01. Order Number DE88753411/JAW.

The non-abelian magnetic monopoles associated with symmetry breaking by the compactification of extra dimensions is considered. We find the monopole solution of the SU(2) gauge theory on $M^4 \times S^1$. It is shown that the compactified space may blow up inside the monopoles.

44141 **(JINR-E—2-87-676) PARISI-SOURLAS type symmetry and hamiltonian BRST formalism.** Kirschner, R. (Joint Inst. for Nuclear Research, Dubna (USSR). Lab. of Theoretical Physics). 1987. 6p. NTIS (US Sales Only), PC A02/MF A01. Order Number DE88703685/JAW.

The BRST symmetry in the extended phase space formalism of Fradkin and Vilkovisky is related to a subgroup of OSP (1, 1/2). Without extending the BRST algebra we understand the formalism on the basis of Parisi - Sourlas reduction. This is because invariance under the corresponding subgroup is sufficient for reduction, which guarantees cancellation of all contributions besides of those satisfying the constraints. 12 refs.

44142 **(JINR-R—17-87-405) Superconformal algebras in two dimensions.** Apikyan, S.A.; Mishonov, T.M. (Nauchnyj Sovet po Kompleksnoj Probleme Kibernetika, AN SSSR). (Joint Inst. for Nuclear Research, Dubna (USSR). Lab. of Theoretical Physics). 1987. 8p. (In Russian). NTIS (US Sales Only), PC A02/MF A01. Order Number DE88703786/JAW.

SO(N) is obtained-invariant algebra of extended superconformal symmetry in two dimensions with arbitrary central containing besides the energy-momentum tensor the current dimensions 1/2, and 3/2. 4 refs.

44143 **(RRK—88-1) Reducing the huge symmetry occurring in the compactification of a string.** Soda, Jiro. (Hiroshima Univ., Takehara (Japan). Research Inst. for Theoretical Physics). Jan 1988. 11p. NTIS (US Sales Only), PC A03/MF A01. Order Number DE88753433/JAW.

For the problem of the huge symmetry which occurs after the compactification, we propose a mechanism of reducing the symmetry. The realistic symmetry is obtained by introducing the para-quantization, whose number and order are determined by the masslessness of graviton. We also discuss the interpretation of our formulation.

44144 **(TRI—87-3) Proceedings of the symposium/workshop on parity violation in hadronic systems.** Page, S.A.; Ramsay, W.D.; van Oers, W.T.H. (eds.). (TRIUMF, Vancouver, British Columbia (Canada)). Dec 1987. 237p. (CONF-8705208—). NTIS (US Sales Only), PC A11/MF A01;1; GPO Dep. Order Number DE88900629/JAW.

From Workshop on parity violations in hadronic systems; Vancouver, UK (28 May 1987).

This report contains papers from the symposium on parity violation in hadronic systems. Most papers discuss parity violation in proton scattering, nucleon-nucleon interactions, weak interactions, particle decay, or polarized electron scattering. (LSP)

44145 **Comment on "Calculating the weak scale in supergravity models".** Drees, M. (Physics Department, University of Wisconsin, Madison, Wisconsin 53706). *Physical Review* [*Section*] *D: Particles and Fields;* **38**: No. 2, 718-720(15 Jul 1988).

Kappen's "Λ-space" approach to radiative symmetry breaking in supergravity models is discussed. It is shown that this approach does not sum the leading-logarithmic radiative corrections. It is also pointed out that the threshold effects in the conventional renormalization-group (RG) approach are much smaller than apprehended by Kappen. It is finally argued that the threshold effects at the ultrahigh scale cannot be determined in the "Λ-space" approach, and that this definition of scalar masses contains the same ambiguities as the RG approach.

44146 **Schwinger terms of the super-Virasoro algebra in (1,0) superspace.** Lee, J.; Louis, J.; Ovrut, B.A. (Department of Physics, University of Pennsylvania, Philadelphia, Pennsylvania 19104). *Physical Review* [*Section*] *D: Particles and Fields;* **37**: No. 12, 3605-3615(15 Jun 1988).

We calculate the Schwinger terms of the super-Virasoro algebra for the heterotic string, and the associated anomalous seagull terms, directly from the Lorentz and super-Weyl anomalies using the (1,0) superspace formalism. The various supercurrents in (1,0) superspace are also discussed.

6454 Field Theory

REFER ALSO TO CITATION(S) 44011, 44013, 44136, 44146

44147 **(DOE/ER/13065—526) Global gauge anomaly of classical groups in even dimension.** Okubo, Susumu; Zhang, Huazhong. (Rochester Univ., NY (USA). Dept. of Physics and Astronomy). 1987. Contract AC02-76ER13065. 17p. (UR—1048). NTIS, PC A03/MF A01; GPO Dep. Order Number DE88008572/JAW.

Explicit expression of global gauge anomaly coefficients $A(\omega)$ of locally anomaly-free representation ω of classical groups SU(N), Sp(2N) and SO(N) have been calculated in even dimensional space-time by uses of group theory and homotopy theory. As a by-product, we will prove some modular relations involving the n-th Kynkin indices Q/sub n/(ω) of these groups. 11 refs.

44148 **(EFI—957(7)-87) Transversity of a massless relativistic membrane.** Laziev, M.E.; Savvidi, G.K. (Erevanskij Fizicheskij Inst. (USSR)). 1987. 12p. NTIS (US Sales Only), PC A03/MF A01. Order Number DE88703487/JAW.

We consider the relativistic theory of the open two-dimensional surface, which is characterized by an action proportional to the volume sweptout by the surface in space time. It is shown that classically there are only D-3 dynamically independent transverse components among the D functions X/sup μ/(σ/sub 1/, σ/sub 2/, tau) which represent the world volume (D is the dimension of space time) and that the surface boundary moves with velocity of light. 4 refs.

44149 **(EFI—961(11)-87) Symmetry breaking in SO(10) grand unified theory and quark masses.** Asatryan, H.M. (Erevanskij Fizicheskij Inst. (USSR)). 1987. 17p. NTIS (US Sales Only), PC A03/MF A01. Order Number DE88703488/JAW.

A model of SO(10) grand unified theory is proposed, where the quark mass spectrum problem occurring in SO(10) breaking schemes with intermediate SU(4)xSU(2)/sub L/xSU(2)/sub R/ or SU(3)/sub C/xU(1)/sub B-L/xSU(2)/sub L/xSU(2)/sub R/ symmetry is solved owing to additional discrete symmetry. With account of this discrete symmetry breaking and from the condition of existence of only one light Higgs boson, a relation between b and t quark masses is obtained, which enables one to fix up the ratio of grand unification scale M/sub x/ to quark-lepton symmetry breaking scale M/sub c/. The concrete values of M/sub x/, M/sub c/ as well as SU(2)/sub R/-symmetry breaking scale M/sub R/ depend on experimental value of Weinberg angle and agree with the proton decay experiments. The problems of mixing of three generations of quarks are being studied within the proposed model. The obtained Kobayashi-Maskawa mixing angles are in good agreement with experiment. 13 refs.; 2 figs.

44150 **(EFI—965(15)-87) Infinite-dimensional gauge Ising model.** Akheyan, A.Z.; Ananikyan, N.S.; Ter-Arutyunyan-Savvidi, N.G. (Erevanskij Fizicheskij Inst. (USSR)). 1987. 15p. NTIS (US Sales Only), PC A03/MF A01. Order Number DE88703489/JAW.

An infinite-dimensional gauge Ising model on the lattice is formulated. The recursion ralations are derived, using which the critical properties of the model are studied. The critical temperatures as well as latent heat of the I-order phase transition are found. The absence of the II-order phase transition in the "pure" Z(Q)-symmetric Potts models at higher dimensions is proved. 10 refs.; 3 figs.; 1 tab.

44151 **(EFI—972(22)-87) Light-cone gauge in the theory of relativistic surfaces.** Savvidi, G.K. (Erevanskij Fizicheskij Inst. (USSR)). 1987. 16p. NTIS (US Sales Only), PC A03/MF A01. Order Number DE88703490/JAW.

A light-like gauge is constructed in the theory of open relativistic surfaces within which part of constraint equations can be solved. In the quantization of the theory in this gauge the Hamiltonian is positively defined, states with negative norm are absent and there arises a real possibility to check up covariance. 15 refs.

44152 **(IC—87/387) Note on Kallosh's quantization proposal.** Diaz, A.V.; Zanelli, J. (International Centre for Theoretical Physics, Trieste (Italy)). Oct 1987. 12p. NTIS (US Sales Only), PC A03/MF A01. Order Number DE88703520/JAW.

The Hamiltonian form of the quantization proposal of Kallosh is presented. It is shown that for infinite stage reducible theories the infinite proliferation of ghosts for ghosts can be avoided. (author). 19 refs, 1 fig.

44153 **(IC—87/389) Super-Poincare covariant canonical formulation of superparticles and Green-Schwarz superstrings.** Nissimov, E.R.; Pacheva, S.J. (International Centre for Theoretical Physics, Trieste (Italy); Bylgarska Akademiya na Naukite, Sofia. Inst. za Yadrena Izsledvaniya i Yadrena Energetika). (International Centre for Theoretical Physics, Trieste (Italy)). Nov 1987. 16p. NTIS (US Sales Only), PC A03/MF A01. Order Number DE88703521/JAW.

First, a new unified covariant formulation simultaneously describing both superparticles and spinning particles is proposed. In this formulation both models emerge as different gauge fixings from a more general point-particle model with larger and gauge invariance. The general model possesses covariant and functionally independent first-class constraints only. Next, the above construction is generalized to the case of Green-Schwarz (GS) superstrings. This allows straightforward application of the Batalin-Fradkin-Vilkovisky (BFV) Becchi-Rouet-Stora-Tyutin (BRST) formalism for a manifestly super-Poincare covariant canonical quantization. The corresponding BRST charge turns out to be remarkably simple and is of rank one. It is used to construct a covariant BFV Hamiltonian for the GS superstring exhibiting explicit Parisi-Sourlas OSp(1,1/2) symmetry. (author). 21 refs.

44154 **(IC—87/390) Manifestly super-Poincare covariant quantization of the Green-Schwarz superstring.** Nissimov, E.R.; Pacheva, S.J. (International Centre for Theoretical Physics, Trieste (Italy); Bylgarska Akademiya na Naukite, Sofia. Inst. za Yadrena Izsledvaniya i Yadrena Energetika). (International Centre for Theoretical Physics, Trieste (Italy)). Nov 1987. 14p. NTIS (US Sales Only), PC A03/MF A01. Order Number DE88703522/JAW.

The Green-Schwarz (GS) superstring is reformulated in a physically equivalent way by embedding it into a larger system containing additional fermionic string- as well as bosonic harmonic variables and possessing additional gauge invariances. The main feature of the new GS superstring system is that it contains covariant and functionally independent first-class constraints only. This allows straightforward application of the BFV-BRST formalism for a manifestly super-Poincare covariant canonical quantization. The corresponding BRST charge turns out to be of second rank and, therefore, the BFV-BRST action contains fourth order ghost terms. (author). 20 refs.

44155 **(IC—87/397) Electromagnetic origin of mass: A classical approach.** Wanas, M.I. (International Centre for Theoretical Physics, Trieste (Italy)). Nov 1987. 21p. NTIS (US Sales Only), PC A03/MF A01. Order Number DE88703523/JAW.

A new solution to the field equations of the generalized field theory, given by Mikhail and Wanas in 1977, has been obtained. The geometry used is that of absolute parallelism with spherical symmetry (type FIGI). The solution represents the generalized field outside a charged central body. The solution allows for the existence of a charged particle whose mass is electromagnetic in origin; and prevents the existence of massless charged particles. A new interpretation of Schwarzschild exterior metric is given. The mass of a body is interpreted as made of two contributions. The first is the gravitational contribution, and the second is the contribution due to the existence of charge. It is shown that the dependence of the type of space in the interpretation of the results obtained, is safer than the dependence on the metric of the associated Riemannian space. (author). 14 refs.

44156 **(IC—87/420) Harmonic superstring and covariant quantization of the Green-Schwarz superstring.** Nissimov, E.; Pacheva, S.; Solomon, S. (International Centre for Theoretical Physics, Trieste (Italy); Bylgarska Akademiya na Naukite, Sofia. Inst. za Yadrena Izsledvaniya i Yadrena Energetika; Weizmann Inst. of Science, Rehovoth (Israel). Dept. of Physics). (International Centre for Theoretical Physics, Trieste (Italy)). Dec 1987. 36p. NTIS (US Sales Only), PC A03/MF A01. Order Number DE88703526/JAW.

Based on our recent work, we describe a new generalized model of space-time supersymmetric strings - the harmonic superstring. It has the same physical content as the original Green-Schwarz (GS) superstring but it is defined on an enlarged superspace: the D=10 harmonic superspace and incorporates additional fermionic string coordinates. The main feature of the harmonic superstring model is that it contains covariant and irreducible first-class constraints only. This allows for a straightforward manifestly super-Poincare covariant Batalin-Fradkin-Vilkoviski (BFV) - Becchi-Rouet-Stora-Tyutin (BRST) quantization. The BRST charge has a remarkably simple form and the corresponding BFV

Hamiltonian exhibits manifest Parisi-Sourlas OSp(1,1/2) symmetry. In a particular Lorentz-covariant gauge we find the covariant vertex operators for the emission of the massless states which closely resemble the covariant "classical" expressions previously guessed by Green and Schwarz. (author). 27 refs.

44157 **(IC—88/4) Path integral formulation of quantum electrodynamics from classical particle trajectories.** Barut, A.O.; Duru, I.H. (International Centre for Theoretical Physics, Trieste (Italy)). Jan 1988. 42p. NTIS (US Sales Only), PC A03/MF A01. Order Number DE88703527/JAW.

The classical particle interactions based on a covariant action principle directly lead, after path integration, to the perturbation expansion of QED and to Feynman graphs without the intermediary of quantized fields. Both scalar electrodynamics and spinor electrodynamics are treated. The latter is based on a covariant classical model of the Dirac electron which already provides the notion of antiparticles and zitterbewegung so that vacuum polarization and pair production can also be discussed. We give a procedure on how classical spin leads to quantum spin in successive time-sliced integrations. (author). 18 refs, 5 figs.

44158 **(IFVE-OTF—87-166) Leading order of 1/N expansion in O(N)xO(N) scalar field theory.** Klimenko, K.G. (Gosudarstvennyj Komitet po Ispol'zovaniyu Atomnoj Ehnergii SSSR, Serpukhov. Inst. Fiziki Vysokikh Ehnergij). 1987. 17p. NTIS (US Sales Only), PC A03/MF A01. Order Number DE88703545/JAW.

Submitted to the journal TMF.

O(N)xO(N) invariant theory (1) with two vector multiplets of scalar fields is considered in the leading order of 1/N expansion. It is shown that the initial symmetry remains intact in space-time dimensions d=2,4. In the case d=3 symmetry may be broken to O(N)xO(N-1) and O(N-1)xO(N-1). 10 refs.; 2 figs.

44159 **(ITEF—48(1987)) Supersymmetry instanton calculus. Instantons in SU(N) supergluodynamics.** Novikov, V.A. (Gosudarstvennyj Komitet po Ispol'zovaniyu Atomnoj Ehnergii SSSR, Moscow. Inst. Teoreticheskoj i Ehksperimental'noj Fiziki). 1987. 28p. (In Russian). NTIS (US Sales Only), PC A03/MF A01. Order Number DE88703594/JAW.

A detailed description of superfield formalism for superinstantons in supersymmetric SU(N) calibration theories is given. A superfield formalism for instantons in SU(2) group is considered. A general solution of classical motion equations is obtained and intermediate formulas for the matter fields in SU(2) theories are derived. A set of these formulas is used when constructing formalism for SU(N) superinstantons without matter. 16 refs.

44160 **(ITEF—190(1987)) String theory in terms of primary quantization. General aspects.** Morozov, A.Yu. (Gosudarstvennyj Komitet po Ispol'zovaniyu Atomnoj Ehnergii SSSR, Moscow. Inst. Teoreticheskoj i Ehksperimental'noj Fiziki). 1987. 18p. (In Russian). NTIS (US Sales Only), PC A03/MF A01. Order Number DE88703610/JAW.

General aspects of string theory in the formation of primary quantization are presented. The structure of perturbation theory in quantum string theory is considered. The main principle of string dynamics which consists in the summing realized only by smooth world surfaces, describing string motion in d-dimensional space-time, is discussed.

44161 **(ITEP—187(1987)) Quantum closed string as a pomeron model.** Vladimirskij, V.V. (Gosudarstvennyj Komitet po Ispol'zovaniyu Atomnoj Ehnergii SSSR, Moscow. Inst. Teoreticheskoj i Ehksperimental'noj Fiziki). 1987. 19p. NTIS (US Sales Only), PC A03/MF A01. Order Number DE88703624/JAW.

There are periodical solutions for equations of a closed string with nonabelian fields, the number of periods per turn l being integer. The classical and quantum considerations of the problem are performed on an example of the σ-model. The classic Regge trajectories at constant l are parabolic, E/sup 2/=A+BJ/sup 2/. All these trajectories have a common extremal tangent J=α/sub R/':4xE/sup 2/. The quantum correction to energy (Casimir effect) shifts the extremal tangent by J(0)=d/sub eff//12. The effective number of massless degrees of freedom d/sub eff/ and the massive excitation effect are estimated. The relationship between this model and the flux-tube model is discussed. 8 refs.

44162 **(ITEP—207(1987)) Two-loop statsum of superstring.** Morozov, A. (Gosudarstvennyj Komitet po Ispol'zovaniyu Atomnoj Ehnergii SSSR, Moscow. Inst. Teoreticheskoj i Ehksperimental'noj Fiziki). 1987. 47p. NTIS (US Sales Only), PC A03/MF A01. Order Number DE88703628/JAW.

It is discussed, whether there is a choice of odd moduli on super-Riemnann surfaces of genus p $\geq$ 2, which leads to vanishing of statistical sums of of superstrings before integration over the space of even moduli. The answer is shown to be positive at least for p=2, when odd moduli are localized at ramification points. relation between various definitions of many-lopp statistical sums in superstring theory is discussed. 30 refs.

44163 **(ITP—87-58) Nonperturbative scale anomaly and dilaton in gauge field theories.** Gusynin, V.P.; Miranskij, V.A. (AN Ukrainskoj SSR, Kiev. Inst. Teoreticheskoj Fiziki). 1987. 13p. NTIS (US Sales Only), PC A03/MF A01. Order Number DE88703631/JAW.

The scale anomaly caused by the dynamics of spontaneous chiral symmetry breaking is studied in vector-like gauge theories. The contribution of this anomaly to the gluon condensate and dilaton mass is determined. The criterion for the realization of the dynamics of a light dilaton is obtained. The applications of these results to quantum chromodynamics and technicolour models are considered. 22 refs.

44164 **(JINR-E—2-87-805) On the stability of the open strings in background electromagnetic field.** Nesterenko, V.V. (Joint Inst. for Nuclear Research, Dubna (USSR). Lab. of Theoretical Physics). 1987. 6p. NTIS (US Sales Only), PC A02/MF A01. Order Number DE88703687/JAW.

Submitted to the journal Phys. Lett., B.

It is shown that the constraint on the strength of an external electric field is absent when the open bosonic string is placed in an external electromagetic field of a special configuration. In the case of four-dimensional space-time it corresponds to the electric and magnetic fields which are equal and perpendicular to each other. The external electromagnetic field does not act on the fermionic variables of the spinning string. 5 refs.

44165 **(JINR-R—2-87-197) Continued groups for physicists.** Dubnichkova, A.Z. (Joint Inst. for Nuclear Research, Dubna (USSR)). 1987. 110p. (In Russian). NTIS (US Sales Only), PC A06/MF A01. Order Number DE88703725/JAW.

The introduction course of lectures on Lie groups is described. Representations and theorems, which are often used in quantum field theory, are used. Basic concepts on group theory are given, linear and vector spaces and operations in them are presented. Infinitesimal operators of Lie groups and their commutation relations are considered. Examples of simple and semi-simple symmetry groups are given. Description does not pretend to mathematical accuracy. Proofs are of the illustrative character. 26 refs.

44166 **(JINR-R—2-87-490) Tachyon production in soliton decays. Exact solution.** Barashenkov, I.V.; Getmanov, B.S.; Kovtun, V.E. (Joint Inst. for Nuclear Research, Dubna (USSR). Lab. of Computing Techniques and Automation; Khar'kovskij Gosudarstvennyj Univ. (Ukrainian SSR)). (Joint Inst. for Nuclear Research, Dubna (USSR). Lab. of Computing Techniques and Automation). 1987. 8p. (In Russian). NTIS (US Sales Only), PC A02/MF A01. Order Number DE88703727/JAW.

Submitted to the journal Phys. Lett. .

Deep-inelastic interaction of solitons is found within the frame of a new integrable relativistic model. The model is a two-field scalar generalization of the sine-Gordon equation furnished

with indefinite metric. The new effects include decays of subliminary solitons with tachyonic solitons emission. 14 refs.; 1 fig.

44167 **(JINR-R—2-87-687) On the Liouville formalism in quantum field theory.** Li Am Gir. (Joint Inst. for Nuclear Research, Dubna (USSR). Lab. of Theoretical Physics). 1987. 30p. (In Russian). NTIS (US Sales Only), PC A03/MF A01. Order Number DE88703732/JAW.

A formalism is investigated of quantum field theory based on the Liouville equation (the Liouville formalism). The Liouville equations are obtained. These are functional Wigner equation in the bosonic case, and functional Naiman equation in the fermionic case. the Green functions of a classical Liouville equation is obtained in the form of a path integral. These are necessary to construct the perturbation theory in the vivinity of the classical field. It is shown that the fermion path integral can be represented in δ-functional form if a fermionic field interacts with a classical field. 19 refs.

44168 **(JINR-R—14-87-534) Radiation of a charged particle moving along a finite trajectory in a medium.** Kobzev, A.P.; Kravchyk, A.; Rutkovski, J. (Joint Inst. for Nuclear Research, Dubna (USSR). Lab. of Neutron Physics). 1987. 11p. (In Russian). NTIS (US Sales Only), PC A03/MF A01. Order Number DE88703780/JAW.

Submitted to the journal NIM.

The expressions for the energy emitted by the charged particle moving along a straight line finite trajectory in a transparent medium have been analyzed. It has been shown that the dependence of the irradiated energy on the particle velocity lacks peculiarities, which may be treated as a threshold. A possibility of dividing the radiation into two parts caused by different mechanisms of the particle-medium interaction has been considered. 14 refs.; 3 figs.

44169 (KEK—87-20, pp 26-31) **SO(10) GUT based on minimal SUGRA.** Hayashi, M.J.; Murayama, Akihiro; Takeshita, Shoji. (Tokai Univ., Hiratsuka, Kanagawa (Japan). Dept. of Physics). Nov 1987. NTIS (US Sales Only), PC A12/MF A01. Order Number DE88780084/JAW. (CONF-8705290—).

From Meeting on physics at TeV energy scale; Oho, Japan (28 May 1987).

A realistic pseudo-left-right symmetric model is investigated in a framework of supersymmetric SO(10) GUT based on the minimal supergravity theory with sliding scales. A two-staged radiative breaking of the gauge symmetry, i.e., SU(2)/sub L/ x SU(2)/sub R/ x U(1)/sub B-L/ -> SU(2)/sub L/ x U(1)/sub Y/ -> U(1)/sub B-L/, is proposed, where the scale of the first stage breaking is comparatively low ($\sim 10^4$ GeV).

44170 (KEK—87-20, pp 74-81) **Yukawa couplings and global symmetries in four-generation superstring models, 1.** Suematsu, Daijiro. (Nagoya Univ. (Japan). Dept. of Physics). Nov 1987. NTIS (US Sales Only), PC A12/MF A01. Order Number DE88780084/JAW. (CONF-8705290—).

From Meeting on physics at TeV energy scale; Oho, Japan (28 May 1987).

We review the general arguments of the discrete symmetries on the Calabi-Yau manifold. Using this argument we investigate the four-generation model compatible with the semi-realistic gauge group and then give the polynomial representations corresponding to the four-dimensional massless fields. We can study the discrete symmetries in detail in terms of the transformation properties of the polynomials under these symmetries.

44171 (KEK—87-20, pp 82-89) **Yukawa couplings and global symmetries in four-generation superstring models, 2.** Mino, Hidetoshi. (Nagoya Univ. (Japan). Dept. of Physics). Nov 1987. NTIS (US Sales Only), PC A12/MF A01. Order Number DE88780084/JAW. (CONF-8705290—).

From Meeting on physics at TeV energy scale; Oho, Japan (28 May 1987).

We have derived the explicit expressions for Yukawa couplings in the four-generation superstring models on a Calabi-Yau mainifold K = K_6G/sub d/ = Y(4; 5)Z_6 x Z_6'. It is shown that among various types of the embedding of G/sub d/ = PI_1(K) into E_6 the most attractive model is the one with the gauge symmetry G = SU(3)/sub C/ x SU(2)/sub L/ x SU(2)/sub R/ x $U(1)^3$ at the compactification scale. In this model quarklepton mass matrices and the longevity of proton are discussed in connection with the R-symmetry.

44172 (KEK—87-20, pp 90-96) **Superstring-inspired SO(10) GUT model with intermediate scale.** Sasaki, Ken. (Yokohama National Univ. (Japan). Faculty of Education). Nov 1987. NTIS (US Sales Only), PC A12/MF A01. Order Number DE88780084/JAW. (CONF-8705290—).

From Meeting on physics at TeV energy scale; Oho, Japan (28 May 1987).

A new mechanism is proposed for the mixing of Weinberg-Salam Higgs fields in the superstring-inspired SO(10) models with no SO(10) singlet fields. The higher-dimensional terms in the superpotential can generate both the Higgs field mixing and a small mass for the physical neutrino.

44173 (KEK—87-23, pp 43-53) **Effective lagrangian from bosonic string field theory.** Nakazawa, Naohito. (Hiroshima Univ., Takehara (Japan). Research Inst. for Theoretical Physics). Dec 1987. NTIS (US Sales Only), PC A13/MF A01. Order Number DE88780085/JAW. (CONF-8706301—).

From Workshop on superstring theory; Oho, Japan (9 Jun 1987).

We investigate the low-energy effective action from the string field theoretical view point. The low-energy effective lagrangian for the massless mode of bosonic string is determined to the order of α′. We find a term which can not be determined from the S-matrix approach.

44174 (KEK—87-23, pp 75-83) **Fermionic construction of N = 1,2 superconformal algebras.** Kobayashi, Ken-ichiro; Odake, Satoru. (Tokyo Univ. (Japan). Dept. of Physics). Dec 1987. NTIS (US Sales Only), PC A13/MF A01. Order Number DE88780085/JAW. (CONF-8706301—).

From Workshop on superstring theory; Oho, Japan (9 Jun 1987).

In connection to string theory and two-dimensional critical phenomena, a great deal of attention has been paid to the conformally and superconformally invariant two-dimensional field theories. Unitary representations of the conformal and superconformal algebras give constraints on possible values of critical indices. For N = 0,1,2 Kac-determinant formurae have been obtained and possible values of the central charge c, highest weight and U(1) charge and corresponding characters for unitary irreducible representation have been derived. Unitary representations of the (super)conformal algebra are realized by several methods (free fermions, free bosons, free fermions and bosons, Z/sub N/-currents and a free boson....). It is known that fermionic representation of (super)conformal algebra is relevant to construct some models which are difficult to realized by bosons or boson-fermion models by projection. In the case of N = 2, representations with C3 ≧ 1 are also important in their relevance to the compactification of superstring. In this report we derive conditions for fermionic construction of N = 1,2 superconformal algebras and obtain some solutions for these conditions.

44175 (KEK—87-23, pp 84-98) **Supersymmetry in the superstrings induced from the bosonic string.** Nojiri, Shinichi. (Kyoto Univ. (Japan). Dept. of Physics). Dec 1987. NTIS (US Sales Only), PC A13/MF A01. Order Number DE88780085/JAW. (CONF-8706301—).

From Workshop on superstring theory; Oho, Japan (9 Jun 1987).

We construct a fermion emission vertex in the previously proposed string model where the heterotic string is generated from the bosonic string in 26 dimensions. The vertex has conformal weight one owing to the contribution of 12 string coordinates which should decouple. This fact suggests that these coordinates are understood to be the superghost and the unphysical Majorana fermions. Furthermore we discuss the 10 dimensional space-time supersymmetry in the model using this vertex.

44176 (KEK—87-23, pp 99-111) **Space-time fermions, superghosts and compactified bosonic string.** Ezawa, Z.F.; Nakamura, S.; Tezuka, A. (Tohoku Univ., Sendai (Japan). Dept. of Physics). Dec 1987. NTIS (US Sales Only), PC A13/MF A01. Order Number DE88780085/JAW. (CONF-8706301—).

From Wörkshop on superstring theory; Oho, Japan (9 Jun 1987).

The compactification of the D = 26 closed bosonic string into D = 10 superstrings is analyzed in the covariant formalism. A mechanism is proposed for the emergence of the SO(9,1) Neveu-Schwarz-Ramond fields and the superghosts together with negative metric states from the "Euclidian" compactified bosonic degrees of freedom. Although after compactification there appear some extra fields, all of them are decoupled consistently.

44177 (KEK—87-23, pp 174-180) **Twisted conformal fields and vertices. Application to superstring.** Kazama, Yoichi; Suzuki, Hisao. (National Lab. for High Energy Physics, Oho, Ibaraki (Japan)). Dec 1987. NTIS (US Sales Only), PC A13/MF A01. Order Number DE88780085/JAW. (CONF-8706301—).

From Workshop on superstring theory; Oho, Japan (9 Jun 1987).

The relation between the oscillator form of the fermion emission vertex and the bosonized form of it is clarified. Based on this observation, we can construct field theoretical NS-R-R vertices which reduce to those constructed by Friedan et al in the limit of string length parameter tending to zero. We can also show that these vertices are O(g) BRST invariant.

44178 **(KEK—87-23) Proceedings of the workshop on superstrings.** Kato, M.; Kazama, Y. (eds.). (National Lab. for High Energy Physics, Oho, Ibaraki (Japan)). Dec 1987. vp. (CONF-8706301—). NTIS (US Sales Only), PC A13/MF A01. Order Number DE88780085/JAW.

From Workshop on superstring theory; Oho, Japan (9 Jun 1987).

Individual papers in these proceedings are abstracted separately. (LEW)

44179 **Still more corrections to the topological mass.** Hagen, C.R.; Panigrahi, P.; Ramaswamy, S. (Department of Physics & Astronomy, University of Rochester, Rochester, New York 14627). *Physical Review Letters;* **61**: No. 4, 389-391(25 Jul 1988).

In an attempt to demonstrate that any parity-nonconserving term can be expected to contribute to the axial-vector part of the current-correlation function, the coupling of charged vector mesons is considered. It is confirmed that parity nonconservation does in fact affect the relevant form factor at zero momentum transfer. Although the result is generally divergent, a finite correction is obtained when a certain sum rule on inverse masses is satisfied. In that limit a single expression is seen to unify the spin-0, spin-1/2, and spin-1 contributions to the so-called topological mass.

44180 **Holonomy transformation and Aharonov-Bohm effect in an Einstein-Maxwell space-time.** Bezerra, V.B. (Center for Theoretical Physics, Laboratory for Nuclear Science dge, Massachusetts 02139). *Physical Review [Section] D: Particles and Fields;* **38**: No. 2, 506-508(15 Jul 1988).

We obtain the exact expression for the holonomy transformation, for a circle, that corresponds to the most general cylindrically symmetric metric. In a particular case that corresponds to solutions of the combined Einstein-Maxwell field equations for this metric, a discussion about the gravitational Aharonov-Bohm effect is given.

44181 **Spectrum of the Casimir effect.** Ford, L.H. (Center for Theoretical Physics, Laboratory for Nuclear Science dge, Massachusetts 02139). *Physical Review [Section] D: Particles and Fields;* **38**: No. 2, 528-532(15 Jul 1988).

The problem of assigning a frequency spectrum to the Casimir effect is studied. The specific case of a massless scalar field with periodicity in one spatial direction is investigated in both two- and four-dimensional spacetime. The spectrum is defined by introducing spectral weight functions which distort the original spectrum of quantum fluctuations and hence reveal the contribution of each frequency interval to the finite Casimir energy. The result is a function $\sigma(\omega)$ whose integral over all frequencies is the total vacuum energy. In order to have $\sigma(\omega)\to 0$ as $\omega\to\infty$, it is necessary to specify a nonzero tolerance $\Delta\omega$ which is the allowed uncertainty in the measurement of the spectrum. In the limit that $\Delta\omega\to 0$, $\sigma(\omega)$ approaches a discontinuous function which does not vanish as $\omega\to\infty$.

44182 **Functional representation of the superconformal group in two dimensions.** Floreanini, R.; Vinet, L. (Center for Theoretical Physics, Laboratory for Nuclear Science Department of Physics, Massachusetts Institute of Technology, Cambridge, Massachusetts 02139). *Physical Review [Section] D: Particles and Fields;* **38**: No. 2, 543-546(15 Jul 1988).

A functional representation for the local supersymmetry transformations of the superconformal group in two dimensions is explicitly constructed. The representation kernel acts on functionals of both a commuting field and a Grassmann field.

44183 **Finite-temperature string theory and twisted tori.** McGuigan, M. (The Rockefeller University, 1230 York Avenue, New York, New York 10021). *Physical Review [Section] D: Particles and Fields;* **38**: No. 2, 552-568(15 Jul 1988).

We show that the introduction of a finite temperature into string theory is mathematically equivalent to compactifying the timelike coordinate on a twisted torus of radius $\beta/2\pi = 1/2\pi kT$, the reciprocal of the temperature. We derive a general formula for the one-loop vacuum amplitude $\Lambda(\beta)$ of a string theory compactified on a twisted torus that is manifestly modular invariant and is almost as easy to apply as in the compactification of a string theory on an ordinary torus. The connection with statistical mechanics is made through the formula $\ln Z(\beta) = -\beta V\Lambda(\beta)$ where $Z(\beta)$ is the partition function and V the volume of the system. We discuss how the function $\sigma(E)$ which counts the number of string states of total energy E and plays a central role in the microcanonical ensemble can be computed by taking the inverse Laplace transform of $Z(\beta)$ and we give estimates of $\sigma(E)$ for low and high energy densities by this method. We study the effect of finite temperature on the effective potentials for different parameters which determine a string theory's compactification. As supersymmetry is broken at finite temperature these potentials are nontrivial. We study the effect of finite temperature on the Wilson loop mechanism for gauge symmetry breaking and find that for a supersymmetric theory compactified on a torus finite-temperature effects favor the trivial vacuum. Also the effective potential for the radius R of the torus becomes modified so as to be minimum at R = 0 or R = ∞. The introduction of interactions and curvature effects into our formalism is discussed.

44184 **Smooth strings at large dimension.** Pisarski, R.D. (Fermi National Accelerator Laboratory, P.O. Box 500, Batavia, Illinois 60510). *Physical Review [Section] D: Particles and Fields;* **38**: No. 2, 578-596(15 Jul 1988).

Surfaces embedded in d Euclidean dimensions with an extrinsic curvature term are investigated. To one-loop order, the effective action for metric fluctuations has a Liouville form over both large and short distances. At large distances, the Liouville theory is the same as for the Nambu model, $\sim$26-d. At short distances, the Liouville action is proportional to 26-2d; this produces negative eigenvalues, and so instability, unless $d \leqq 13$. At large d, this instability is overlooked to compute correlation functions by an expansion in $\sim 1/d$. There is a critical point when the renormalized string tension vanishes, with the only infrared singular correlations those of the Liouville theory over large distances, $\sim$26-d. At the critical point, there is also a tachyon at nonzero momentum; tachyons probably do not occur if $d<26$.

44185 **Chiral gauge theories on a lattice and application to the chiral Schwinger model.** Aoki, S. (Physics Department, Brookhaven National Laboratory, Upton, New York 11973). *Physical Review [Section] D: Particles and Fields;* **38**: No. 2, 618-626(15 Jul 1988).

We derive a chiral gauge-invariant lattice fermion action from a chiral gauge-variant Wilson fermion action without changing its partition function. By using this formula we show that anomalous gauge theories are renormalizable in four dimensions and we investigate the chiral Schwinger model. We calculate the induced mass for the gauge boson compatible with the gauge invariance and show that this model is gauge invariant and unitary for a range of Wilson parameter r at the fermion one-loop level.

44186 **Quarks, noise, and the lattice.** Kennedy, A.D.; Kuti, J.; Meyer, S.; Pendleton, B.J. (Supercomputer Computations Research Institute, Florida State University, Tallahassee, Florida 32306). *Physical Review* [*Section*] *D: Particles and Fields;* **38**: No. 2, 627-635(15 Jul 1988).

We describe a noisy Monte Carlo method for numerical simulation of quantum chromodynamics (QCD) including the dynamical effects of light quarks. A family of link variables is updated simultaneously using an unbiased estimate of the ratio of fermion determinants. The algorithm permits large (heat-bath size) update steps to be made with no uncontrollable systematic errors. It is shown theoretically that in the limit when each link is changed by a small step simultaneously the master equation of the noisy Monte Carlo algorithm becomes identical to the Fokker-Planck equation of the popular Langevin method. We present detailed results for a large range of couplings and masses on 4^4 lattices with staggered fermions. Prospects for realistic calculations on large lattices are discussed.

44187 **Improved presentation of a novel perturbative scheme in field theory.** Brown, N. (Physics Department, Brookhaven National Laboratory, Upton, New York 11973). *Physical Review* [*Section*] *D: Particles and Fields;* **38**: No. 2, 723-724(15 Jul 1988).

Bender et al. have recently proposed a novel perturbative scheme to analyze self-interacting scalar field theories. Calculations, however, require the use of complicated polynomial interactions for which no general expression has been found. The answers obtained have then to be acted on by a complex differential operator. We propose an alternative approach involving an interaction Lagrangian of only two terms, which presents the whole scheme in a simple way, as well as having some calculational advantage.

44188 **Chiral bosonization and local Lorentz-invariant actions for chiral bosons.** Sanielevici, M.N.; Semenoff, G.W.; Wu, Y. (Center for Theoretical Physics, Laboratory for Nuclear Science dge, Massachusetts 02139). *Physical Review Letters;* **60**: No. 25, 2571-2574(20 Jun 1988).

We formulate a geometrical theory of self-dual scalar fields in two dimensions with a local Lorentz-invariant action. Path-integral quantization is used to derive chiral Bosonization by demonstrating equivalence of correlation functions of currents and energy-momentum tensors in our theory with those for Weyl fermions.

44189 **Critical behavior in (2+1)-dimensional QED.** Appelquist, T.; Nash, D.; Wijewardhana, L.C.R. (Physics Department, Yale University, New Haven, Connecticut 06511). *Physical Review Letters;* **60**: No. 25, 2575-2578(20 Jun 1988).

QED in 2+1 dimensions, analyzed in the 1/N expansion, is shown to exhibit a critical behavior as the number N of fermions approaches $32/\pi^2$. The dynamical mass has a universal scaling behavior at the critical point. The existence of criticality is discovered first by an analytic study of the gap equation and the effective potential. Its existence and universality is then confirmed numerically. Similarities to four-dimensional theories are discussed.

44190 **Gravitational field of a global string.** Harari, D.; Sikivie, P. (Physics Department, University of Florida, Gainesville, Florida 32611). *Physical Review* [*Section*] *D: Particles and Fields;* **37**: No. 12, 3438-3440(15 Jun 1988).

The gravitational field of a straight global string is derived in the linear approximation to general relativity, and the resulting trajectories of test particles are found. Part of the gravitational effect of global strings is a deficit angle which increases logarithmically with the distance to the string core. In this regard, a global string resembles a gauge string. A new feature, not present for gauge strings, is a repulsive gravitational potential outside the core. The lensing properties of the global string, as well as other classical effects, are studied.

44191 **Quantum fields out of thermal equilibrium.** Eboli, O.; Jackiw, R.; Pi, S. (Center for Theoretical Physics, Laboratory for Nuclear Science dge, Massachusetts 02139). *Physical Review* [*Section*] *D: Particles and Fields;* **37**: No. 12, 3557-3581(15 Jun 1988).

The isoentropic, but energy-nonconserving, time evolution of mixed quantum states is studied in quantum mechanics and quantum field theory. A variational principle, which gives the Liouville—von Neumann equation, is implemented approximately by making a Gaussian Ansatz for the density matrix. The dynamical equations governing the parameters that define the Ansatz satisfy equations variously analogous to the Schroedinger equation and to mechanical problems. Interesting nonequilibrium evolution is found in special cases, as, for example, when the analog Schroedinger equation gives rise to reflectionless transmission. For field theory in an external, time-dependent metric we obtain equations that were previously derived in the many-field (spherical-model) limit.

44192 **Excited-state vertices for type-I superstrings.** Clavelli, L.; Harms, B. (Department of Physics and Astronomy, University of Alabama, Tuscaloosa, Alabama 35487). *Physical Review* [*Section*] *D: Particles and Fields;* **37**: No. 12, 3622-3627(15 Jun 1988).

Requiring conformal invariance and invariance under the G gauges, we construct Lorentz-covariant vertices for the emission of excited states of the type-I superstring.

44193 **Four-quark interactions in finite-temperature, SU(2), lattice gauge theory.** Kiskis, J. (Department of Physics, University of California, Davis, California 95616). *Physical Review* [*Section*] *D: Particles and Fields;* **37**: No. 12, 3679-3683(15 Jun 1988).

Non-Gaussian critical exponents for the confinement-deconfinement phase transition in SU(2) lattice gauge theory indicate that the associated three-dimensional field theory of Wilson lines has nontrivial interactions. A numerical approximation to the first derivative of the effective potential for the lines is used to estimate the strength of the four-line interaction. Moderate to strong coupling is found. This indicates that at the scale of the string tension, the four-quark free energy differs substantially from the contribution made by pairwise strings.

44194 **Complex Langevin solution to an effective theory of lattice QCD.** Bilic, N.; Gausterer, H.; Sanielevici, S. (Rudjer Boskovic Institute, 41001 Zagreb, Yugoslavia). *Physical Review* [*Section*] *D: Particles and Fields;* **37**: No. 12, 3684-3690(15 Jun 1988).

By means of a complex Langevin algorithm, we simulate on the full group space an effective three-dimensional theory of QCD at finite temperature and finite chemical potential. We study the effect of the chemical potential on the first-order character of the deconfinement phase transition.

44195 **Finite-size effects and phase transitions.** Berg, B.A.; Billoire, A.; Salvador, R. (Supercomputer Computations Research Institute and Department of Physics, The Florida State University, Tallahassee, Florida 32306). *Physical Review* [*Section*] *D: Particles and Fields;* **37**: No. 12, 3774-3777(15 Jun 1988).

We perform numerical simulations of SU(2) lattice gauge theory on $4L^2 64$ lattices with $4 \leq L \leq 16$. A finite-size scaling analysis of the tunneling signal extrapolates the critical coupling β/sub c/ (relevant for the deconfining phase transition with N/sub t/ = 4) toward the infinite-volume limit and yields $2.28 < \beta$/sub c/ < 2.32. We illustrate the method with exact results for the two-dimensional and numerical results for the three-dimensional Ising model. For finite systems the notion of a "phase transition" is discussed critically. Geometry is important and the deconfining phase transition is not sharp on lattices that are relevant for spectrum calculations.

65 PHYSICS II

44196 (ANL/NDM—104) Some thoughts on positive definiteness in the consideration of nuclear data covariance matrices. Geraldo, L.P.; Smith, D.L. (Argonne National Lab., IL (USA)). Jan 1988. Contract W-31-109-ENG-38. 67p. NTIS, PC A04/MF A01; 1; GPO Dep. Order Number DE88012426/JAW.

Some basic mathematical features of covariance matrices are reviewed, particularly as they relate to the property of positive definiteness. Physical implications of positive definiteness are also discussed. Consideration is given to an examination of the origins of non-positive definite matrices, to procedures which encourage the generation of positive definite matrices and to the testing of covariance matrices for positive definiteness. Attention is also given to certain problems associated with the construction of covariance matrices using information which is obtained from evaluated data files recorded in the ENDF format. Examples are provided to illustrate key points pertaining to each of the topic areas covered.

6510 Nuclear Physics

REFER ALSO TO CITATION(S) 44254, 44259

44197 (BNL-NCS—41382) Medium energy nuclear data for applications. Pearlstein, S. (Brookhaven National Lab., Upton, NY (USA)). 1988. Contract AC02-76CH00016. 5p. (CONF-880546—21). NTIS, PC A02/MF A01; 1; GPO Dep. Order Number DE88012526/JAW.

From International conference on nuclear data for science and technology; Mito, Japan (30 May 1988).

The types of medium energy nuclear data required for applications are discussed. Features of analysis tools, consisting of both detailed nuclear model codes and simple formulas based on nuclear systematics are presented. The activities of the Medium Energy Nuclear Data Working Group (MENDWG) are described including the recent benchmark comparison of nuclear model codes. 40 refs., 7 figs.

44198 (BNL-NCS—41383) Nuclear Reaction Data Centers. McLane, V.; Nordborg, C.; Lemmel, H.D.; Manokhin, V.N. (Brookhaven National Lab., Upton, NY (USA)). 1988. Contract AC02-76CH00016. 4p. (CONF-880546—22). NTIS, PC A02/MF A01; 1; GPO Dep. Order Number DE88012525/JAW.

From International conference on nuclear data for science and technology; Mito, Japan (30 May 1988).

The cooperating Nuclear Reaction Data Centers are involved in the compilation and exchange of nuclear reaction data for incident neutrons, charged particles and photons. Individual centers may also have services in other areas, e.g., evaluated data, nuclear structure and decay data, reactor physics, nuclear safety; some of this information may also be exchanged between interested centers. 20 refs., 1 tab.

44199 (DOE/ER/40048—213-L9) [Experimental and theoretical nuclear physics]: 1988 Annual report. (Washington Univ., Seattle (USA). Nuclear Physics Lab.). May 1988. Contract AC06-81ER40048. 105p. NTIS, PC A06/MF A01; 1; GPO Dep. Order Number DE88012991/JAW.

This paper describes the highlights of the past year of the Nuclear Physics Laboratory at the University of Washington. Particular topics discussed are: astrophysics, giant resonance, heavy ion induced reactions, fundamental symmetries, nuclear reactions, medium energy reactions, accelerator mass spectrometry, Van de Graaf and ion sources, the booster linac project, instrumentation and computer systems. (LSP)

44200 (INIS-mf—11114) Collective motion and giant resonances. Proceedings of the 15th Mikolajki summer school on nuclear physics. Mikolajki, Poland, September 5-17, 1983. Seminars. Wilhelmi, Z.; Kicinska-Habior, M. (eds.). (Warsaw Univ. (Poland). Inst. Fizyki Doswiadczalnej). 1984. 221p. (CONF-8309169—). NTIS (US Sales Only), PC A10/MF A01. Order Number DE88701749/JAW.

From 15. international summer school in nuclear physics; Mikolajki, Poland (5 Sep 1983).

The report contains 15 papers devoted to problems of giant collective excitations of nuclei, heavy-ion induced reactions and their bearing on various aspects of nuclear structure. In some of them the numerical data are given. (A.S.).

44201 (INIS-mf—11114, pp 132-149) Light particle emission in nuclear reactions. Betak, E. (Institute of Physics EPRC SAS, Bratislava (Czechoslovakia)). 1984. NTIS (US Sales Only), PC A10/MF A01. Order Number DE88701749/JAW. (CONF-8309169—).

From 15. international summer school in nuclear physics; Mikolajki, Poland (5 Sep 1983).

Parallels between the light particle emission in reactions induced by both light particles and heavy ions are presented. Some trends observed in heavy-ion induced reactions are reasoned. The interplay of competing mechanisms of the light particle emission in heavy ion reactions is illustrated.

44202 (INIS-mf—11114, pp 150-157) Investigations of low energy light particles emitted in ^{22}Ne and ^{40}Ar-induced reactions. Sowinski, M.; Soltan, A.; Lewitowicz, M.; Skobelev, N.K. (Joint Inst. for Nuclear Research, Dubna (USSR). Lab. of Nuclear Reactions). 1984. NTIS (US Sales Only), PC A10/MF A01. Order Number DE88701749/JAW. (CONF-8309169—).

From 15. international summer school in nuclear physics; Mikolajki, Poland (5 Sep 1983).

Subbarrier light charged particles emitted in the reactions of ^{22}Ne (E/sub LAB/ = 178 MeV) and ^{40}Ar (E/sub LAB/ = 221 MeV) with /sup nat/Ag, ^{159}Tb, ^{181}Ta, ^{197}Au, ^{232}Th and ^{238}U targets have been investigated for the first time. The strong component of these particles in inclusive energy spectra can not be explained by evaporation from compound nucleus or from fully accelerated fission fragments. For the explanation of this the ternary fission in heavy ion reactions has been proposed.

44203 (JINR-R—3-87-770) Investigation of neutron reactions followed by charged particle emission (status and perspectives). Popov, Yu.P. (Joint Inst. for Nuclear Research, Dubna (USSR). Lab. of Neutron Physics). 1987. 10p. (In Russian). NTIS (US Sales Only), PC A02/MF A01. Order Number DE88703745/JAW.

The main results of the (n, α) and (n, p) reaction investigations on resonance neutrons has been considered. It has been shown that at the neutron binding energy the fragmentation of four quasiparticle states is considerably more complete than that of single particle ones. The role of (n, p) reaction in parity nonconservation research and astrophysics has been discussed. The ways of extension of (n, α) and (n, p) reaction investigations in the resonance and fast neutrons region are discussed. 32 refs.; 5 figs.

6512 Nuclear Properties And Reactions, A=1-5, Experimental

44204 Energy dependence of the charge asymmetry A(T/sub π/,θ) in πd elastic scattering. Smith, G.R.; Gill, D.R.; Ottewell, D.; Wait, G.D.; Walden, P.; Johnson, R.R.; Olszewski, R.; Rui, R.; Sevior, M.E.; Trelle, R.P.; and others. (TRIUMF, Vancouver, British Columbia, Canada V6T 2A3). *Physical Review [Section] C: Nuclear Physics;* **38**: No. 1, 240-250(Jul 1988).

Angular distributions of charge asymmetry A(T/sub π/,θ), have been measured for πd elastic scattering. Data were obtained in the backward hemisphere for pion bombarding energies of 143, 180, 220, and 256 MeV. The results are compared with predictions employing different mass and width parameters for the delta isobars.

44205 **Measurement of the difference in R = σ/sub L//σ/sub T/ and of σ/sup A//σ/sup D/ in deep-inelastic e-D, e-Fe, and e-Au scattering.** Dasu, S.; de Barbaro, P.; Bodek, A.; Harada, H.; Krasny, M.W.; Lang, K.; Riordan, E.M.; Arnold, R.; Benton, D.; Bosted, P.; and others. (University of Rochester, Rochester, New York 14627). *Physical Review Letters;* 60: No. 25, 2591-2594(20 Jun 1988).

We measured the differences in R = σ/sub L//σ/sub T/ and the cross-section ratio σ/sup A//σ/sup D/ in deep-inelastic electron scattering from D, Fe, and Au nuclei in the kinematic range $0.2 \leqq x \leqq 0.5$ and $1 \leqq Q^2 \leqq 5$ (GeV/c)^2. Our results for R/sup A/-R/sup D/ are consistent with zero for all x and Q^2, indicating that possible contributions to R from nuclear higher-twist effects and spin-0 constituents in nuclei are not different from those in nucleons. The European Muon Collaboration effect is reconfirmed, and the low-x data from all recent experiments, at all Q^2, are now in agreement.

6513 Nuclear Properties And Reactions, A=6-19, Experimental

44206 **(CONF-880260—8) Energy dependence of complete and incomplete fusion in the ^{28}Si + ^{12}C reaction.** Mateja, J.F.; Vineyard, M.F.; Kovar, D.G.; Beck, C.; Henderson, D.J.; Janssens, R.V.F.; Wilkins, B.D.; Prosser, F.W.; Maguire, C.F.; Stephans, G.S.F. (Argonne National Lab., IL (USA)). 1988. Contract W-31109-ENG-38. 5p. NTIS, PC A02/MF A01;1; GPO Dep. Order Number DE88010026/JAW.

From 5. winter workshop on nuclear dynamics; Sun Valley, ID, USA (22 Feb 1988).

To study possible entrance channel effects in certain heavy-ion reactions and to investigate the dependence of such processes on heavier projectiles, measurements involving a pulsed ^{28}Si beam and ^{12}C target were performed using the ANL ATLAS facility. TOF measurements at ^{28}Si bombarding energies of 11.0, 14.3, and 16.1 MeVu were carried out to establish the total evaporation residue cross section behavior for complete and incomplete fusion. 4 figs., 1 tab.

44207 (INIS-mf—11114, pp 60-69) **Spectroscopic quadrupole moment of ^{7}Li.** Weller, A.; Blatt, K.; Egelhof, P. (Max-Planck-Institut fuer Kohlenforschung, Muelheim an der Ruhr (Germany, F.R.); Marburg Univ. (Germany, F.R.). Fachbereich 13 Physik; Basel Univ. (Switzerland). Inst. fuer Physik). 1984. NTIS (US Sales Only), PC A10/MF A01. Order Number DE88701749/JAW. (CONF-8309169—).

From 15. international summer school in nuclear physics; Mikolajki, Poland (5 Sep 1983).

An experiment determining the ground state quadrupole moment of ^{7}Li by Coulomb scattering of aligned nuclei has been performed. The observable tensor analyzing power T_{20} is up to second order proportional to the spectroscopic quadrupole moment of the projectile. An optimized experimental setup allowed a systematic investigation of T_{20} at different energies as well as using different target nuclei. Data are presented and results are given in the framework of a semiclassical and a quantum-mechanical analysis based on the coupled channel method. Q/sub s/ = -37.43 emb and B(E2) = 8.12 e^{2}fm^4 were obtained. The errors are in the order of 1 emb and 0.5 e^{2}fm^4 respectively.

44208 (INIS-mf—11114, pp 70-81) **Heidelberg polarized heavy ion source.** Tungate, G.; Kraemer, D.; Becker, K. (Max-Planck-Institut fuer Kernphysik, Heidelberg (Germany, F.R.); Marburg Univ. (Germany, F.R.). Fachbereich 13 Physik). 1984. NTIS (US Sales Only), PC A10/MF A01. Order Number DE88701749/JAW. (CONF-8309169—).

From 15. international summer school in nuclear physics; Mikolajki, Poland (5 Sep 1983).

The new polarized source at the Heidelberg MP tandem is described. Measurements of beams polarization for ^{7}Li at 44 MeV and ^{23}Na at 110 MeV are presented. Optical pumping as a method of producing high polarization is discussed.

44209 (INIS-mf—11114, pp 82-116) **Spin orientation and resonances in single- and mutual-inelastic ^{12}C+^{12}C scattering.** Konnerth, D.; Duennweber, W.; Hering, W. (Muenchen Univ. (Germany, F.R.). Sektion Physik). 1984. NTIS (US Sales Only), PC A10/MF A01. Order Number DE88701749/JAW. (CONF-8309169—).

From 15. international summer school in nuclear physics; Mikolajki, Poland (5 Sep 1983).

Motivated by the aligned-coupling picture of molecular resonances we have studied the spin orientation of ^{12}C(2$^+$) from ^{12}C+^{12}C single and double inelastic scattering at E/sub cm/ = 15-35 MeV. From the out-of-plane distribution of the particle coincident γ-radiation we derive the spin alignment P/sub zz/ with respect to the scattering normal. The spatial correlations of both γ-rays from double inelastic scattering, detected eventwise with the Darmstadt-Heidelberg crystal ball, are shown to determine the absolute value of m(abs.m) -correlation probabilities P/sub abs.m(sub 1)/ /sub abs.m(sub 2)/ of the magnetic substates of both nuclei. These quantities vary strongly as a function of the scattering angle and energy. In contrast to the expectation of aligned coupling, P/sub zz/ is rather small on the average. A clear correlation is found for P/sub zz/(E) and σ(E) in the case of double inelastic scattering. The contributions from the doubly aligned configuration ($abs.m_1 = abs.m_2 = 2$) show the most dramatic energy dependence. We suggest to modify the aligned-coupling concept by taking into account the deformation of ^{12}C and the tendency of the dinuclear system to achieve the sticking configuration.

44210 **(INS—668) 3α fragmentation processes of ^{12}C at Eu = 10 - 30 MeV.** Kubono, S.; Oertzen, W. von; Bohlen, H.G.; Stilliaris, E.; Sakuragi, Y.; Kamimura, M. (Tokyo Univ., Tanashi (Japan). Inst. for Nuclear Study). Jan 1988. 7p. NTIS (US Sales Only), PC A02/MF A01. Order Number DE88753412/JAW.

Energy dependence of 3α fragmentation processes has been studied in the scattering of ^{12}C + ^{12}C at Eu = 10 - 30 MeV. The dynamical polarization potential induced by the fragmentation processes indicates a rapid increase of the normalization from 8 to 35 % for the real part of the elastic diagonal potential in this energy region.

44211 **(ITEF—185(1987)) Disintegration of /sup 16/O and /sup 14/N nuclei with /sup 12/C/sup */(2/sup +/,4.44 MeV) production in the (π,πγ) experiment.** Vasenko, A.A.; Kirpichnikov, I.V.; Korotkikh, V.L.; Kuznetsov, V.A.; Lanskoj, D.E.; Starostin, A.S. (Gosudarstvennyj Komitet po Ispol'zovaniyu Atomnoj Ehnergii SSSR, Moscow. Inst. Teoreticheskoj i Ehksperimental'noj Fiziki). 1987. 20p. (In Russian). NTIS (US Sales Only), PC A03/MF A01. Order Number DE88703608/JAW.

The differential cross sections of /sup 16/O and /sup 14/N nucleus disintegration with emission of some nucleons are measured with the pion beam with 2.0 GeV/c momemtum. The role of direct interactions of PI/sup +/ -meson with nuclear nucleons and clusters at scattering angles psi/sub (sup PI)//sup +/>5 deg is analyzed. Thus, at /sup 16/O (PI/sup +/, PI', CHI)/sup 12/C/sup */(2/sup +/) reaction analysis it is shown, that three mechanisms: direct quasielastic knock-out of α-clusters; knock.out of α-cluster with its simultaneous breakup, knock-out of nucleon followed by emission of three-nucleon association by the residue - play the essential role in /sup 12/C* (2/sup +/) residual nuclei production. 16 refs.; 5 figs.

44212 **(ITEF—198(1987)) Measurement of total cross sections of proton interaction with Li-6, Li-7, Be-9 nuclei at 2 GeV/c.** Dukhovskoj, I.A.; Zaretskij, V.M.; Krestnikov, Yu.S. and others. (Gosudarstvennyj Komitet po Ispol'zovaniyu Atomnoj Ehnergii SSSR, Moscow. Inst. Teoreticheskoj i Ehksperimental'noj Fiziki). 1987. 9p. (In Russian). NTIS (US Sales Only), PC A02/MF A01. Order Number DE88703611/JAW.

Total cross sections of proton interaction with /sup 6/Li, /sup 7/Li and /sup 9/Be nuclei at 2 GeV/c, σ/sub tot/(p/sup 6/Li)=(236.8+-3.4+-3.6) mb, σ/sub tot/(p/sup 7/Li)=(256.9+-3.6+-3.9) mb, σ/sub tot/(p/sup 9/Be)=(318.7+-4.2+-4.8) mb are

measured (the first error is statistical, the second - systematic). The results are compared with calculations by the Glauber-Sitenko theory. 9 refs.; 3 figs.

44213 (JINR-E—1-87-549) High statistics measurement of the nucleon structure function F/sub 2/(x,Q/sup 2/) from deep inelastic muon-carbon scattering at high Q/sup 2/. Benvenuti, A.C.; Bollini, D.; Bruni, G. and others. (Bologna Univ. (Italy). Ist. di Fisica; Istituto Nazionale di Fisica Nucleare, Bologna (Italy)). (Joint Inst. for Nuclear Research, Dubna (USSR). Lab. of High Energy). 1987. 12p. NTIS (US Sales Only), PC A03/MF A01. Order Number DE88703676/JAW.

Submitted to the journal Phys. Lett., B.

Results from a high statistics study of the nucleon structure function F/sub 2/(x, Q/sup 2/), (where x-Feynamn variable, Q/sup 2/-squared four-momentum transfer) measured in deep inelastic scattering of muons on carbon in the kinematic range $0.25 \leqq x \leqq 0.80$ and Q/sup 2/ $\geqq$ 25 GeV/sup 2/ are presented. The analysis is based on 1.5x10/sup 6/ reconstructed events recorded at beam energies of 120, 200 and 280 GeV. The ratio R=σ/sub L//σ/sub T/ of absorption cross sections for virtual photons of longitudinal and transverse polarization is found to be independent of x in the range $0.25 \leqq x \leqq 0.7$ and 40 GeV/sup 2/ $\leqq$ Q/sup 2/ $\leqq$ 200 GeV with a mean value R=0.015 +- 0.013 (stat.) +- 0.26 (syst.). 10 refs.; 4 figs.; 6 tabs.

44214 (JINR-R—1-87-71) Determination of nucleon form factor on the basis of data from π/sup +/+/sup 7/Li -> e/sup +/+e/sup -/+X reaction at 380 MeV pion kinetic energy. Baturin, V.N.; Kravtsov, A.V.; Blokhintseva, T.D.; Kuptsov, A.V.; Luchan, L.; Nemenov, L.L.; Pustyl'nik, Zh.P.; Kurochkin, V.P. (AN SSSR, Leningrad. Inst. Yadernoj Fiziki; Joint Inst. for Nuclear Research, Dubna (USSR). Lab. of Nuclear Problems; Moskovskij Gosudarstvennyj Univ. (USSR). Nauchno-Issledovatel'skij Inst. Yadernoj Fiziki). (Joint Inst. for Nuclear Research, Dubna (USSR). Lab. of Nuclear Problems). 1987. 7p. (In Russian). NTIS (US Sales Only), PC A02/MF A01. Order Number DE88703711/JAW.

Submitted to the journal Sov. J. Nucl. Phys. .

Experimental data on inverse electroproduction of pions on /sup 7/Li nuclei (π/sup +/+/sup 7/Li -> e/sup +/+e/sup -/+X) at the kinetic pion energy 380 MeV have been analysed. Earlier detected $\sim$ 260 events were grouped into three intervals in the squared transferred momenta k/sup 2/ of the e/sup +/e/sup -/ pair, with mean values being k/sub 1//sup 2/ =0.09 (GeV/c)/sup 2/; k/sub 2//sup 2/=0.15 (GeV/c)/sup 2/; k/sub 3//sup 2/=0.22 (GeV/c)/sup 2/. For each k/sup 2/ interval the number of the events with the electron and positron energy over 70 MeV (those electrons and positrons emitted at angles $\sim$ 65 deg with respect to the pion beam) is determined, and the corresponding cross sections calculated. Δ/sub σ/(k/sub 1//sup 2/)=(2.43+-0.70)x10/sup -33/ cm/sup 2/; Δ/sub σ/(k/sub 2//sup 2/)=(2.14+-0.29)x10/sup -33/ cm/sup 2/; Δ/sub σ/(k/sub 3//sup 2/)=(2.05+-0.27)x10/sup -33/ cm/sup 2/. The solid angle of the set-up is 0.2 sr/sup 2/. The isovector form factor of the nucleon F/sub 1//sup v/ is determined for each k/sup 2/ interval to taking into account the effective number of neutrons in the /sup 7/Li nucleus (3.6+-0.1): F/sub 1//sup v/(k/sub 1//sup 2/)=1.6/sub -0.21//sup +0.18/; F/sub 1//sup v/(k/sub 2//sup 2/)=1.53/sup -0.09+0.08/; F/sub 1//sup v/(k/sub 3//sup 2/)=1.88/sub -0.10//sup +0.10/. 14 refs.; 2 figs.; 1 tab.

44215 Δ electroproduction and inelastic charge scattering from carbon and iron. Baran, D.T.; Filippone, B.F.; Geesaman, D.; Green, M.; Holt, R.J.; Jackson, H.E.; Jourdan, J.; McKeown, R.D.; Milner, R.G.; Morgenstern, J.; and others. (Physics Division, Argonne National Laboratory, Argonne, Illinois 60439-4843). *Physical Review Letters;* **61**: No. 4, 400-403(25 Jul 1988).

Electroproduction of the Δ isobar in C and Fe has been studied for incident electrons with energies between 0.6 and 1.6 GeV. A longitudinal-transverse decomposition of the inclusive cross section has been made for q/sub μ/^{2} = 0.1 (GeV/c)^2. The residual longitudinal cross sections measured do not provide the additional strength needed above the quasifree region to satisfy the Coulomb sum rule. The transverse cross sections are in good agreement with data from photoabsorption.

44216 Cross section for the /sup 12/C(/sup 139/La,X)/sup 11/C reaction at relativistic energies. Smith, A.R.; Hill, J.C.; Winger, J.A.; Karol, P.J. (Lawrence Berkeley Laboratory, Berkeley, California 94720). *Physical Review [Section] C: Nuclear Physics;* **38**: No. 1, 210-212(Jul 1988).

The cross section for the /sup 12/C(/sup 139/La,X)/sup 11/C reaction was measured using 1.26-GeV/nucleon /sup 139/La ions. Annihilation radiation from the decay of /sup 11/C was counted using a large volume NaI(Tl) detector. The resulting cross section for /sup 139/La was 147.9 +- 2.0 mb. The results are compared with similar measurements using relativistic ^{4}He, /sup 12/C, /sup 20/Ne, and /sup 56/Fe projectiles and the predictions of a linear transport model.

44217 Proton and neutron transition densities in /sup 6,7/Li from low energy neutron and proton scattering. Hansen, L.F.; Rapaport, J.; Wang, X.; Barrios, F.A.; Petrovich, F.; Carpenter, A.W.; Threapleton, M.J. (Lawrence Livermore National Laboratory, Livermore, California 94550). *Physical Review [Section] C: Nuclear Physics;* **38**: No. 1, 525-528(Jul 1988).

New elastic and inelastic neutron scattering data for /sup 6,7/Li taken at 24.0 MeV have been analyzed in conjunction with existing proton scattering data for these targets at 24.4 MeV. The new data allow us to infer that rho/sub n/$\cong$rho/sub p/ in ^{6}Li and ^{7}Li in contrast with the results rho/sub n/$\cong$(N/Z)rho/sub p/ deduced from earlier proton and electron work.

44218 Effect of entrance channel asymmetry on fusion reactions leading to compound nuclei with A = 40,42. Harmon, B.A.; Shapira, D.; Stelson, P.H.; Burks, B.L.; Erb, K.A.; Shivakumar, B.; Teh, K.; Thornton, S.T. (Oak Ridge National Laboratory, Oak Ridge, Tennessee 37831). *Physical Review [Section] C: Nuclear Physics;* **38**: No. 1, 572-575(Jul 1988).

Cross sections for the fusion of /sup 28/Si+/sup 12/C and /sup 30/Si+/sup 12/C have been measured at energies between 6.4 and 9.4 MeV/nucleon and 5.2 and 8.3 MeV/nucleon, respectively. Comparison with existing data for compound systems with A = 40 and 42 shows that the extracted critical angular momentum at saturation (l/sub cr//sup max/) depends strongly on the entrance channel mass asymmetry. This effect is not accounted for by the standard entrance channel or compound nucleus models. A calculation of the conditional saddle-point shapes for touching spheroidal nuclei indicates that this mass asymmetry effect is a consequence of the dynamical fusion thresholds at high angular momentum. Quantitative agreement is obtained with the experimentally measured l/sub cr//sup max/ using the finite range model of Sierk for diffuse-surface nuclei.

44219 Search for bound states of the eta meson in light nuclei. Chrien, R.E.; Bart, S.; Pile, P.; Sutter, R.; Tsoupas, N.; Funsten, H.O.; Finn, J.M.; Lyndon, C.; Punjabi, V.; Perdrisat, C.F.; and others. (Brookhaven National Laboratory, Upton, New York 11973). *Physical Review Letters;* **60**: No. 25, 2595-2598(20 Jun 1988).

A search for nuclear-bound states of the eta meson has been carried out. Targets of lithium, carbon, oxygen, and aluminum were placed in a π^+ beam at 800 MeV/c. A predicted eta bound state in /sup 15/O/sup */ (E/sub x/$\cong$540 MeV) with a width of $\cong$9 MeV was not observed. A bound state of a size (1/3 of the predicted cross section would have been seen in this experiment at a confidence level of 3σ (P>0.9987).

44220 Projectile fragmentation of the extremely neutron-rich nucleus /sup 11/Li at 0.79 GeV/nucleon. Kobayashi, T.; Yamakawa, O.; Omata, K.; Sugimoto, K.; Shimoda, T.; Takahashi, N.; Tanihata, I. (National Laboratory for High Energy Physics (KEK), Tsukuba, Ibaraki 305, Japan). *Physical Review Letters;* **60**: No. 25, 2599-2602(20 Jun 1988).

Projectile fragmentations of /sup 11/Li, ^{8}He, and ^{6}He have been measured at 0.79 GeV/nucleon. Production cross sections and

momentum distributions of the produced isotopes (Z≧2)= are measured inclusively. Transverse-momentum distributions of ^{9}Li from the fragmentation of /sup 11/Li show two Gaussian components of different width. The width of the wide component is consistent with the values observed in the fragmentation of stable nuclei, whereas the other component shows an extremely narrow width reflecting the weak binding of the two outer neutrons in the /sup 11/Li nucleus.

6514 Nuclear Properties And Reactions, A=20-38, Experimental

44221 (INIS-mf—11114, pp 25-34) **^{23}Na(p,γ)^{24}Mg reaction at subbarrier energies interpreted in terms of the direct-semidirect model.** Kicinska-Habior, M.; Decowski, P.; Matulewicz, T.; Sikora, B.; Toke, J.; Cseh, J.; Somorjai, E. (Warsaw Univ. (Poland). Inst. Fizyki Doswiadczalnej; 3873000HU). 1984. NTIS (US Sales Only), PC A10/MF A01. Order Number DE88701749/JAW. (CONF-8309169—).

From 15. international summer school in nuclear physics; Mikolajki, Poland (5 Sep 1983).

Continuing investigations of the proton capture process on odd-Z nuclei with the main aim to study the GDR effects the ^{23}Na(p,γ)^{24}Mg reaction at two non-resonant energies was measured. The measurements were carried out on the 3 MeV Warsaw Van de Graff accelerator. The investigation showed enhanced transitions pointing to effects of GDR decays populating the find states. (M.F.W.).

44222 (INIS-mf—11114, pp 47-59) **Study of three-nucleon transfer in the reaction ^{28}Si(α,p) at E/sup lab//sub α/ =26 MeV.** Jankowski, K.; Grzeszczuk, A.; Siemaszko, M.; Surowiec, A.; Zipper, W.; Budzanowski, A.; Kozik, E. (Uniwersytet Slaski, Katowice (Poland). Inst. Fizyki; Institute of Nuclear Physics, Krakow (Poland)). 1984. NTIS (US Sales Only), PC A10/MF A01. Order Number DE88701749/JAW. (CONF-8309169—).

From 15. international summer school in nuclear physics; Mikolajki, Poland (5 Sep 1983).

Differential cross sections for the ^{28}Si(α,p)^{31}P reaction have been measured at an incident alpha energy of 26 MeV. The measurements corresponding to 17 transitions to the states of ^{31}P extend over laboratory angles from 20 deg to 165 deg. The angular distributions were analyzed assuming a presence of direct and compound nucleus reaction mechanism. The three-nucleon spectroscopic factors have been extracted.

6515 Nuclear Properties And Reactions, A=39-58, Experimental

44223 (CEA-CONF—9310) **Capture cross sections and gamma-ray spectra from the interactions of 0.5 to 3.0 MeV neutrons with nuclei in the mass range A-45 to 238.** Voignier, J.; Joly, S.; Grenier, G. (CEA Centre d'Etudes de Bruyeres-le-Chatel, 91 (France)). 1987. 4p. (CONF-8708101—). NTIS (US Sales Only), PC A02/MF A01. Order Number DE88754045/JAW.

From 6. international symposium on capture gamma-ray spectroscopy; Leuven, Belgium (31 Aug 1987).

Absolute neutron capture cross sections of /sup 45/Sc, /sup 141/Pr, /sup 165/Ho, /sup nat/Lu and /sup 238/U have been measured in the 0.5 to 3.0 MeV energy range. The corresponding gamma-ray spectra due to the capture of 0.5 MeV neutrons on /sup 141/Pr, /sup 165/Ho, /sup nat/Lu and /sup 238/U are presented as well as a comparison between different data concerning the radiative capture cross section of /sup 238/U.

44224 (IC—88/57) **Multiparticle emission in the pre-equilibrium decay of light and heavy nuclei in α-induced reaction up to 60 MeV.** Afzal Ansari, M.; Rizvi, I.A.; Bhardwaj, M.K.; Chaubey, A.K. (International Centre for Theoretical Physics, Trieste (Italy); Aligarh Muslim Univ. (India). Dept. of Physics). (International Centre for Theoretical Physics, Trieste (Italy)). Mar 1988. 22p. NTIS (US Sales Only), PC A03/MF A01. Order Number DE88703535/JAW.

α-particle induced excitation functions for the reactions /sup 55/Mn(α,n)/sup 58/Co, /sup 55/Mn(α,2n)/sup 57/Co, /sup 55/Mn(α,3n)/sup 56/Co, /sup 55/Mn(α,4n)/sup 55/Co, /sup 55/Mn(α,αn)/sup 54/Mn, /sup 55/Mn(α,2p3n)/sup 54/Mn, /sup 55/Mn(α,α3n)/sup 52/Mn, /sup 209/Bi(α,3n)/sup 210/At and /sup 209/Bi(α,4n)/sup 209/At have been measured up to 60 MeV α-particle using the stack foil activation technique. The reactions /sup 55/Mn(α,4n)/sup 55/Co and /sup 55/Mn(α,α3n)/sup 52/Mn have been studied for the first time. The theoretical comparison with a pre-equilibrium (PE) geometry dependent hybrid (GHD) model has been made. The initial exciton number n/sub 0/=4 with different configurations (1n+2p+1h), (2n+2p+0h) and (2n+1p+1h) has been tested. It is found that configuration (2n+2p+0h) is the best set of choice. The pre-equilibrium fraction f/sub PE/ of the total excitation function has also been calculated at different excitation energy. (author). 23 refs, 10 figs, 2 tabs.

44225 (ITEF—165(1987)) **Limitation on /sup 48/Ca 2β decay existence with majoron emission.** Barabash, A.S. (Gosudarstvennyj Komitet po Ispol'zovaniyu Atomnoj Ehnergii SSSR, Moscow. Inst. Teoreticheskoj i Ehksperimental'noj Fiziki). 1987. 4p. (In Russian). NTIS (US Sales Only), PC A02/MF A01. Order Number DE88703602/JAW.

Limitations for the half-life of the 2β(0NUCHI/sup 0/)-decay of /sup 48/Ca (T/sub 1/2/ > 8.6 x 10/sup 20/ years) and for the coupling constant of the majoron to the neutrino (g < 6.7 x 10/sup -4/) have been extracted from data obtained earlier in the 2β-decay experiment with /sup 48/Ca. 7 refs.

44226 **Studies of emissions of complex fragments and effective temperatures for collisions of /sup 58/Ni+/sup 58/Ni at 11 MeV/nucleon.** Gomez del Campo, J.; Charvet, J.L.; D'Onofrio, A.; Auble, R.L.; Beene, J.R.; Halbert, M.L.; Kim, H.J. (Oak Ridge National Laboratory, Oak Ridge, Tennessee 37831). *Physical Review Letters;* **61**: No. 3, 290-293(18 Jul 1988).

Complex fragments of nuclear charge Z from 4 to 13 were measured at five laboratory angles using surface-barrier-detector telescopes. Coincident γ rays were measured in a 4π geometry using 64 NaI detectors. Kinematical analysis of the fragments revealed that those of Z between 4 and 9 are consistent with the decay of a compound nucleus formed in a complete fusion reaction. γ rays of excited states of /sup 12/C, /sup 15/N, and /sup 16/O were measured and effective temperatures of about 2 MeV were extracted. Hauser-Feshbach calculations reproduce the measured cross sections and the effective temperatures very well.

44227 **Collective motion in nucleus-nucleus collisions at 800 MeV/nucleon.** Danielewicz, P.; Stroebele, H.; Odyniec, G.; Bangert, D.; Bock, R.; Brockmann, R.; Harris, J.W.; Pugh, H.G.; Rauch, W.; Renfordt, R.E.; and others. (Institute of Theoretical Physics, Warsaw University, 00-681 Warsaw, Poland Gesellschaft fuer Schwerionenforschung, D-6100 Darmstadt 11, Federal Republic of Germany Lawrence Berkeley Laboratory, University of California, Berkeley, California 94720 Fachbereich Physik, Universitaet Marburg, D-3550 Marburg,). *Physical Review* [*Section*] *C: Nuclear Physics;* **38**: No. 1, 120-134(Jul 1988).

Semicentral Ar+KCl, La+La, and Ar+Pb collisions at 800 MeV/nucleon were studied using a streamer chamber. The results are analyzed in the framework of the transverse momentum analysis and in terms of the average sphericity matrix. A critical examination of the analysis procedures, both experimental and theoretical, is given. New procedures are described to account for overall momentum conservation in the reaction, and to correct for azimuthal variations in the detection efficiency. Average transverse momenta per nucleon in the reaction plane are presented for deuterons emit-

ted in the forward hemisphere, as these provide the most reliable information. A Vlasov-Uehling-Uhlenbeck calculation with a stiff equation of state gives a good fit to the momenta in the Ar+Pb reaction. Flow effects parametrized further using the sphericity tensor are found stronger than in the cascade model and consistently weaker than predicted by hydrodynamics. Parameters from the sphericity tensor exhibit a larger variation as a function of multiplicity than do the average momenta per nucleon.

6516 Nuclear Properties And Reactions, A=59-89, Experimental

44228 **(CRN-PN—87-15) Realization and development of neutron multiplicity filter. Application to /sup 69/Se excited state study and to two-neutron emission in beta-decay of /sup 30/Na.** Ramdane, M. (Strasbourg-1 Univ., 67 (France). Centre de Recherches Nucleaires). Jul 1987. 111p. (In French). NTIS (US Sales Only), PC A06/MF A01. Order Number DE88754053/JAW.

A neutron multiplicity filter including seven independent elements, with a whole volume of 26 liters, filled up with NE213 liquid scintillator, has been realized and studied in detail. The following characteristics have been obtained: a 10 MeV neutron detection efficiency equal to 50%; a neutron - gamma discrimination very satisfactory for neutron energy above 200 KeV, a fast timing in the nanosecond region and undoubted response for multiplicity. This filter allows to study nuclei far from stability very neutron deficient produced in low cross-section outgoing channels of fusion-evaporation reactions. Particularly, the first information on the structure of /sup 69/Se has been obtained. The investigation of the /sup 30/Na decay with this device has led to the first direct observation of the two-neutron emission.

44229 **(INIS-mf—11114, pp 35-46) Evidence of the Fermi motion effects on the linear momentum transfer in the ^{4}He + ^{59}Co reaction.** Fatyga, M.; Jastrzebski, J.; Karwowski, H.J.; Mroz, T.; Singh, P.P.; Vigdor, S.E. (Institute of Nuclear Research, Warsaw (Poland); Indiana Univ., Bloomington (USA)). 1984. NTIS (US Sales Only), PC A10/MF A01. Order Number DE88701749/JAW. (CONF-8309169—).

From 15. international summer school in nuclear physics; Mikolajki, Poland (5 Sep 1983).

Thick target recoil ranges of radioactive products formed in the ^{4}He + ^{59}Co reaction are determined for incident energies 30-200 MeV. The average value of the transferred linear momentum for reaction channels, leading to these products is deduced. It is argued that this average value is close to the average for all reaction channels, ending in radioactive as well as stable products. The transferred average linear momentum exhibits a maximum for incident alpha particle energy per nucleon equal to the average kinetic energy of the Fermi motion. For the same bombarding energy the leveling-off of the maximum transferred momentum is observed.

44230 **(JINR-R—4-87-440) Study on interference effect in the /sup 67/Zn(n,α/sub 0/) and /sup 145/Nd(n,α/sub 0/) reactions.** Rigol, H. (Joint Inst. for Nuclear Research, Dubna (USSR). Lab. of Neutron Physics). 1987. 6p. (In Russian). NTIS (US Sales Only), PC A02/MF A01. Order Number DE88703746/JAW.

The effect of interference in the /sup 145/Nd(n,α/sub 0/) and /sup 67/Zn(n,α/sub 0/) reactions is discussed. The presence of this effect in the α/sub 0/-disintegration it is the α-transitions to the bound state. That can be deduced from the contradiction between the experimental values for thermal cross sections of these reactions and theoretical calculations of all known neutron resonances using the extrapolation of the Breit-Wigner formula for thermal neutrons. In this analysis the same formalism is used that has been developed for the analysis of interference in the (n,p) reaction. It will be demonstrated that using these results one cannot get a reliable information about the parameters of the bound state. 9 refs.; 4 tabs.

44231 **Test of the singly magic character of the N = 50 isotone /sup 83/As populated in /sup 83/Ge decay.** Winger, J.A.; Hill, J.C.; Wohn, F.K.; Gill, R.L.; Ji, X.; Wildenthal, B.H. (Ames Laboratory and Iowa State University, Ames, Iowa 50011). *Physical Review [Section] C: Nuclear Physics;* **38**: No. 1, 285-294(Jul 1988).

The first information obtained on excited states of the N = 50 isotone /sup 83/As populated in the β decay of neutron-rich / sup 83/Ge is presented. The /sup 83/Ge half-life was measured to be 1.85 +- 0.06 s. Using γ singles and γγ coincidence measurements, a total of 51 γ rays were placed in a level scheme for /sup 83/As corresponding to 28 levels in a range of excitation energy up to 4.84 MeV. The density of levels up to 2.0 MeV excitation energy is reasonably well reproduced by shell-model calculations, indicating that /sup 78/Ni is probably a doubly magic nucleus. Approximately half of the β intensity to excited states in /sup 83/As populates a group of levels above 3.5 MeV excitation energy which can be interpreted as primarily core polarization neutron particle-neutron hole states.

6517 Nuclear Properties And Reactions, A=90-149, Experimental

44232 **(DOE/ER/40321—2) The onset of multifragmentation in La-induced reactions.** Mignerey, A.C. (Maryland Univ., College Park (USA)). 1987. Contract FG05-87ER40321. 17p. (CONF-871243—8). NTIS, PC A03/MF A01. Order Number DE88008238/JAW.

From Symposium on hot nuclei; College Station, TX, USA (7 Dec 1987).

Reactions of the 50-MeVu La beam have been studied. By choosing a range of target masses, the mechanisms can be studied over a broad range of excitation energies. These studies focus in the intermediate mass fragments (IMF's) with $Z > 2$ emitted in these reactions. Reactions with a carbon target show a component consistent with sequential emission from an equilibrated source. After correcting for light particle evaporation, a compound Z of {approximately}60 is obtained, with linear momentum transfers of {approximately}50% and excitation energies of {approximately}250 MeV. Reactions with an Al target still show a component of compound nucleus decay, with a clear correlation between coincident IMF's. The sum charge distribution for two-body coincident events is very narrow and peaked at $Z = 50$. The transition to a Cu target is striking in that the correlation goes away, and the Z_1-Z_2 coincidence plot shows a broad range of sum charges peaking around $Z = 40$, indicating greater than two-body decays. Reactions with the La target give much lighter IMF's, with their Z_1-Z_2 sum charge distribution weighted to $Z < 30$ 10 refs., 13 figs., 1 tab.

44233 **(JINR-R—1-87-809) Emission of heavy nuclides in deep spallation reactions.** Herrmann, E.; Barashenkov, V.S.; Novgorodov, A.F.; Khalkin, V.A. (Martin-Luther-Universitaet Halle-Wittenberg, Halle (German Democratic Republic)). (Joint Inst. for Nuclear Research, Dubna (USSR). Lab. of Nuclear Problems). 1987. 14p. (In Russian). NTIS (US Sales Only), PC A03/MF A01. Order Number DE88703721/JAW.

Submitted to the journal Isotopenpraxis.

Emission of products of spallation reactions with mass numbers A=147-173 from a tantalum target irradiated by 660 MeV protons has been investigated. Measurement results and experimental data for small energies and various targets are compared to cascade-evaporation model of nuclear reactions. Calculations are in agreement with experiment. The relations allowing to estimate the yield of neutron-deficient nuclides from thick targets have been obtained. 19 refs.; 7 figs.; 3 tabs.

44234 **(KIYI—87-13) Nuclear excitation by positrons at boundary energy of 2,6 and 4,2 MeV.** Borozenets, G.P.; Vishnevskij, I.N.; Zheltonozhskij, V.A.; Kharlanov, V.B. (AN Ukrainskoj SSR, Kiev. Inst. Yadernykh Issledovanij). 1987. 14p. (In Russian). NTIS (US Sales Only), PC A03/MF A01. Order Number DE88703795/JAW.

The studies of nuclear excitation were continued in positron annihilation. As the sources of positrons the radioactive nuclei of /

sup 52/Mn and /sup 66/Ga were used. The effective cross sections of given process were determined. The method is proposed for the determination of integral and differential cross sections in a region of quasi-continuous spectrum of excited states. It is shown that the experimental data are overestimated no less than in two orders as compared with theoretical calculations. 17 refs.; 7 figs.

44235 **(KIYI—87-18) /sup 93m/Mo decay.** Belyavenko, V.S.; Vishnevskij, I.N.; Zheltonozhskij, V.A. (AN Ukrainskoj SSR, Kiev. Inst. Yadernykh Issledovanij). 1987. 10p. (In Russian). NTIS (US Sales Only), PC A02/MF A01. Order Number DE88703796/JAW.

The presice measurement of relative intensities of γ-rays of /sup 93m/Mo, populating /sup 93/Mo was made and nagular γγ-corrections of directions of γ-ray cascade were measured, one of which has E4+M5 multipolarity. The internal conversion coefficent value (CIC) for γ 263 keV were defined more accurately. It was determined that CIC for E4-transition is decreased on (5.2+-3.8)% as compared with theoretical values. It was determined, that the isomeric transition between the states 21.2/sup +/ -> 13.2/sup +/ has the multipolarity E4+(0.1+-0.16)%MS, and the value is δ=-0.038+-0.022. 16 refs.; 3 figs.

44236 **(LPCC-T—87-01) Emission study of quasi-projectile fragments produced in reactions induced by /sup 40/Ar ions at 60 MeV/nucleon.** Thiphagne, A. (Caen Univ., 14 (France). Lab. de Physique Corpusculaire). Jun 1987. 116p. (In French). NTIS (US Sales Only), PC A06/MF A01. Order Number DE88754062/JAW.

It is presented experimental results obtained upon the GANIL facility (CAEN). The experiment measured angular and energy distributions of fragments emitted in the interactions of /sup 40/Ar with Silver and Gold targets at 60 MeV/nucleon beam energy. The analysis of these data allowed the following conclusions: - transfer reaction still play an important role at this intermediate energy; - the major part of the distributions of Argon-like fragments correlated with light particles arise from a process of sequential decay of an excited primary projectile-like nucleus. - A Monte-Carlo calculation accounting for Coulomb effects shows that the decay occurs at about 100 Fm far from the target. - the excitation energy of the primary nucleus - which does not exceed 50 MeV - is found clearly less than the value expected from thermal equilibration between projectile-like and target-like nuclei.

44237 **(LYCEN-T—8724) Nuclear moments of nuclei near sphericity.** El Hajjaji, O. (Lyon-1 Univ., 69 - Villeurbanne (France). Inst. de Physique Nucleaire). May 1987. 77p. (In French). NTIS (US Sales Only), PC A05/MF A01. Order Number DE88754063/JAW.

Magnetic and electric hyperfine interactions are studied by means of low temperature nuclear orientation. The magnetic moment of the /sup 149/Gd isotope and that of /sup 151/Gd are determined. The values follow the same trend as literature values of neighbouring nuclei. The calculated moments of the 7/2/sup -/ states using the Mottelson-Nilsson model without configuration mixing are nearly independent of deformation. Thus we assign the decrease of the magnetic moment versus neutron number to many particle coupling in the f shell. The Moessbauer effect detection of nuclear orientation is discussed. Two series of experiences are performed with different finalities. In the first one we determined the electric quadrupole moments of /sup 125m/Te and /sup 129/Te. The quadrupole moments confirm the nearly spherical shape of these nuclei. In the second series we describe the Moessbauer effect of the radiation emitted by the daigleter nucleus of /sup 125/I, implanted in two semiconductor matrices, locally oriented at low temperature by the electric field gradient of impurity-vacancy coupling. Despite the difficulty of the cooling down of Te nuclei to lattice temperature, we have shown the existence of the electric field gradient of implanted I into Si and α-Sn and determined their signs. The level mixing resonance is applied on oriented nuclei technique to determine the weak prolate deformation of silver nuclei. Studying the Δm = 3 resonance of /sup 107/Ag/sup m/, we etablished the quadrupole moment of this state, which is in good agreement with the theoretical estimations of Moeller and Nix.

44238 **Inclusive neutron spectra at 0° from Nb-Nb and Au-Au collisions at 800 MeV/nucleon.** Madey, R.; Zhang, W.; Anderson, B.D.; Baldwin, A.R.; Flanders, B.S.; Pairsuwan, W.; Varga, J.; Watson, J.W.; Westfall, G.D. (Kent State University, Kent, Ohio 44242). *Physical Review [Section] C: Nuclear Physics;* **38**: No. 1, 184-194(Jul 1988).

Inclusive neutron spectra were measured at 0° from Nb-Nb and Au-Au collisions at 800 MeV/nucleon. The spectra in the rest frame of the projectile were decomposed into three Gaussians with standard deviations of 55 +- 4, 114 +- 12, and 259 +- 22 MeV/c for Nb-Nb collisions, and 56 +- 4, 110 +- 10, and 279 +- 15 MeV/c for Au-Au collisions. Physical processes associated with each Gaussian are discussed. The dependence of the parameters of the three Gaussians on the impact parameter indicates that the temperature of the spectators excited by peripheral collisions is lower than that excited by nonperipheral collisions, that projectile neutrons involved in nonperipheral collisions have a broader momentum distribution than those involved in peripheral collisions, and that an observed high-energy tail has its origin primarily in nonperipheral collisions. The high-energy tail is explained well by collective backscattering of neutrons in the target from nucleon clusters in the projectile with a mean cluster size of about 1.3 in both Nb and Au.

44239 **Decay of /sup 143/Ba to levels of the odd-proton N = 86 nuclide /sup 143/La.** Faller, S.H.; Robertson, J.D.; Baum, E.M.; Chung, C.; Stone, C.A.; Walters, W.B. (Department of Chemistry, University of Maryland, College Park, Maryland 20742). *Physical Review [Section] C: Nuclear Physics;* **38**: No. 1, 307-322(Jul 1988).

The level structure of /sup 143/La has been investigated by measurement of gamma-ray and conversion-electron singles, gamma-gamma coincidence, and gamma-gamma angular correlation spectra following the decay of 15.0-s /sup 143/Ba. Comparison of the observed structure of /sup 143/La with the structures of isotopic La and isotonic N = 86 nuclides, as well as those of the adjacent Cs isotopes and N = 84 isotones, suggests the presence of unusual low-lying $(3/2^+$ and $(5/2^-$ levels that are not readily accounted for by theoretical calculations. The observed structures suggest that the deformation in this mass region is influenced by different factors than that of the nuclides above Z = 64, and that reflection asymmetric structures play an important role in the structure of the nuclides in the A = 145 mass region.

6518 Nuclear Properties And Reactions, A=150-189, Experimental

44240 (INIS-mf—11114, pp 117-131) **Gamma-ray multiplicity studies in heavy-ion induced reactions.** Kamanin, V.V.; Kugler, A.; Oganessian, Yu.Ts.; Penionzhkievich, Yu.E.; Ruediger, J. (Joint Inst. for Nuclear Research, Dubna (USSR)). 1984. NTIS (US Sales Only), PC A10/MF A01. Order Number DE88701749/JAW. (CONF-8309169—).

From 15. international summer school in nuclear physics; Mikolajki, Poland (5 Sep 1983).

The average γ-ray multiplicity and its variance were studied in the reaction $^{160}Gd(^{16}O,4\text{-}8n)^{175-168}Hf$ and were found out to be practically constant in the range of oxygen ion energies from 80 to 134MeV. The γ-ray multiplicity of the evaporation residues as a function of the energy of the α and Li particles, emitted in the direction of the beam, was measured for the incomplete fusion channels of the reactions $^{22}Ne(145MeV\text{-}165MeV)+^{181}Ta$ and $^{12}C(100MeV)+$ /sup nat/Ir. The evaporation residues were identified by means of characteristic X-rays, which are emitted when internal conversion in the γ-deexcitation chain occurs. This technique allowed us to determine γ-multiplicity corresponding to emission of the preequilibrium α particles with very high energies. For the case of α particle emission, the spin of the residual system was determined from the observed anisotropy of the fission fragments. The difference between the spin in the fission channel and the spin in the evaporation channel increases with the increasing energy of the emitted α particle. This observation leads us to the assumption of the existence of a very broad distribution in the value of the angle

between the direction of an emitted preequilibrium α particle and the normal to the nuclear surface in the reaction under study.

44241 **(JINR-R—3-87-513) Cascade γ-decay of compound states of /sup 163/Dy,/sup 167/Er and /sup 179/Hf nuclei.** Boneva, S.T.; Vasil'eva, Eh.V.; Popov, Yu.P.; Sukhovoj, A.M.; Khitrov, V.A.; Yazvitskij, Yu.S. (Joint Inst. for Nuclear Research, Dubna (USSR). Lab. of Neutron Physics). 1987. 19p. (In Russian). NTIS (US Sales Only), PC A03/MF A01. Order Number DE88703742/JAW.

Submitted to the journal Zeit. Phys. .

The results of study of two-quanta cascades in the compound nuclei /sup 163/Dy, /sup 167/Er and /sup 179/Hf are given. The qualitative explanation of the difference in observed and calculated cascade intensities was achieved under assumption that partial widths cascade transitions depend on one-quasiparticle components of the three levels connected with them. In a comparison with earlier data on /sup 165/Dy and /sup 175/Yb there was revealed a considerable growth of the radiative strength function for the E2-transitions in deformed nuclei with decreasing energy. 10 refs.; 6 figs.; 2 tabs.

44242 **(JINR-R—6-87-98) On a reliability of determination of γ-decay schemes by the summation method of amplitudes of coincidence momenta.** Boneva, S.T.; Vasil'eva, Eh.V.; Sukhovoj, A.M. (Joint Inst. for Nuclear Research, Dubna (USSR). Lab. of Neutron Physics). 1987. 10p. (In Russian). NTIS (US Sales Only), PC A02/MF A01. Order Number DE88703749/JAW.

Submittd to the journal Izv. AN SSSR, Ser. Fiz. .

Excited state interval of a complex nucleus accessible to investigation was extended at least by twice by the method of summation of amplitudes of coinciding pulses (SACP) from two Ge(Li) detectors. The analysis of influence of background $\gamma\gamma$-coincidences on a reliability of determined γ-decay scheme is performed. The probability of inclusion of a false level into final result is evaluated by the mathematical simulation method. The probability of availability of least one false level in γ-decay schemes of /sup 178,179/Hf nucleus investigated by the SACP method does not exceed 10% at E <or approx. 3.5 MeV excitation energy. 9 refs.; 4 figs.

44243 **(JINR-R—6-87-787) Nonadiabatic effects of electromagnetic transitions in the /sup 164/Er nucleus.** Gromov, K.Ya.; Islamov, T.A.; Usmanov, P.N. (Joint Inst. for Nuclear Research, Dubna (USSR). Lab. of Nuclear Problems; Joint Inst. for Nuclear Research, Dubna (USSR). Lab. of Theoretical Physics; Tashkentskij Gosudarstvennyj Univ. (USSR); AN Uzbekskoj SSR, Tashkent. Inst. Yadernoj Fiziki). (Joint Inst. for Nuclear Research, Dubna (USSR). Lab. of Nuclear Problems; Joint Inst. for Nuclear Research, Dubna (USSR). Lab. of Theoretical Physics). 1987. 10p. (In Russian). NTIS (US Sales Only), PC A02/MF A01. Order Number DE88703752/JAW.

Submitted to the Orgcommittee of 38. Conference on nuclear spectroscopy and structure of atomic nucleus.

Analysis of experimental data on low-lying states of positive parity in /sup 164/Er obtained in precise investigations of spectra of internal conversion electrons, γ-rays and γ-γ-coincidences at the /sup 164/Er decay is carried out. Calculations in the framework of the phenomenological model, in which mixing of gr-, β-, γ- and K/sup π/=1/sup +/ band states are performed too. The spectrum of states, reduced E2-transition probability ratios of R/sub JK/ and multipolarity mixing ratio δ for transition from γ-band to ground state band are calculated. The comparison with experiment which shows satisfactory agreement with theory is presented. The discrepancy between R/sub JK/ and Alagas rule is explained. 20 refs.; 2 figs.; 4 tabs.

6519 Nuclear Properties And Reactions, A=190-219, Experimental

44244 **(BNL—41354) Measurement of energy flow from oxygen, silicon and proton interactions with nuclei at the BNL Tandem-AGS.** Tannenbaum, M.J. (Brookhaven National Lab., Upton, NY (USA)). 1988. Contract AC02-76CH00016. 10p. (CONF-880399—6). NTIS, PC A02/MF A01; 1; GPO Dep. Order Number DE88012520/JAW.

From 23. Rencontre de Morioud: current issues in hadron physics; Les Arcs, France (13 Mar 1988).

Measurements with a 160 beam of total energy 232 GeV and a 28Si beam of total energy 406 GeV at the BNL Tandem-AGS are reported. A lead glass array recorded the energy emitted by interactions of the beams with targets of C, Al, Cu, Ag and Au, while a beam calorimeter detected any remnant energy of the projectile after interaction. The shapes of the energy spectra imply that incident 14.5 GeV/c nucleons lose most of their energy in the first few collisions in a nucleus. It is shown that 160 and 28Si nuclei at this energy can be substantially stopped by nuclei the size of Cu. 8 refs., 9 figs.

44245 **(JINR-R—1-87-509) Production of 5-12 charge fragments in the p + Au reaction at 2.6-7.5 GeV proton energy.** Avdejchikov, V.V.; Bogdanov, A.I.; Ganza, E.A. and others. (Radievyj Inst., Leningrad (USSR)). (Joint Inst. for Nuclear Research, Dubna (USSR). Lab. of High Energy). 1987. 9p. (In Russian). NTIS (US Sales Only), PC A02/MF A01. Order Number DE88703714/JAW.

Inclusive differential cross sections for the production of fragments with charges Z/sub F/=5-12 at the laboratory angle of 88 deg in collisions of protons with gold nuclei at the kinetic energies E/sub p/ of 2.55, 3.36, 4.18, 5.02, 5.85 and 7.51 GeV are presented. Fragment energy range is 1.2-10 MeV/nucleon. The dependence of tau from the approximation σ(Z/sub F/)~Z/sub F// sup -tau/ in proton energy range 2.6-7.5 GeV is given by tau(E/sub p/)=2.24-0.045E/sub p/. In this proton energy range tau(E/sub p/) does not reveal any features characteristic of the fragment production through the condensation in the "gas-liquid" phase transition. 26 refs.; 7 figs.; 2 tabs.

44246 **(JINR-R—1-87-609) Inclusive differential cross sections of the fragments with charges 5-12 production in / sup 4/He nuclei at 1.3-13.5 GeV energy interaction with Au nuclei.** Avdejchikov, V.V.; Bogdanov, A.I.; Budilov, V.A. (Radievyj Inst., Leningrad (USSR); Joint Inst. for Nuclear Research, Dubna (USSR). Lab. of High Energy). (Joint Inst. for Nuclear Research, Dubna (USSR). Lab. of High Energy). 1987. 18p. (In Russian). NTIS (US Sales Only), PC A03/MF A01. Order Number DE88703718/JAW.

Tables of experimental inclusive differential cross sections for the production of 5-12 charge fragments in the 1.1-12 MeV/nucleon range at the laboratory angle of 88 deg are presented. The fragments are produced by the /sup 4/He nuclei with energies from 1.3 to 13.5 GeV interacting with gold nuclei. The measurements have been performed on JINR synchrophasotron using telescopes of semiconductor silicon detectors and thin foil target placed within the accelerator chamber. 8 refs.; 16 tabs.

44247 **(JINR-R—1-87-709) Inclusive differential cross sections of the intermediate mass fragment (Z=5-12) production in 13.5 GeV /sup 4/He nuclei interaction with gold nuclei.** Avdejchikov, V.V.; Bogdanov, A.I.; Budilov, V.A. and others. (Radievyj Inst., Leningrad (USSR); Joint Inst. for Nuclear Research, Dubna (USSR). Lab. of High Energy). (Joint Inst. for Nuclear Research, Dubna (USSR). Lab. of High Energy). 1987. 18p. (In Russian). NTIS (US Sales Only), PC A03/MF A01. Order Number DE88703719/JAW.

Tables of experimental inclusive differential cross sections for the formation of fragments with charges 5-12 in the energy range 1.1-12 MeV/nucleon at the laboratory angles 39 deg, 54 deg, 100 deg, 123 deg, 127 deg and 135 deg are presented. The fragments are produced by the /sup 4/He nuclei with energy 13.5 GeV interacting with Au nuclei. The measurements have been performed

on JINR synchrophasotron using telescopes of semiconductor silicon detectors and thin foil target placed within the accelerator chamber. 5 refs.; 16 tabs.

44248 **(JINR-R—1-87-830) Observation of minimum in energy dependence of tau parameter of charge fragment yield in relativistic /sup 4/He nucleus interaction with gold nuclei.** Avdejchikov, V.V.; Bogdanov, A.I.; Budilov, V.A. and others. (Radievyj Inst., Leningrad (USSR)). (Joint Inst. for Nuclear Research, Dubna (USSR). Lab. of High Energy). 1987. 4p. (In Russian). NTIS (US Sales Only), PC A02/MF A01. Order Number DE88703722/JAW.

Submitted to the journal JETP Lett. .

Charge yields for the formation of fragments with charges Z5-12 in the laboratory angle range of 35-135 deg in collisions of / sup 4/He particles with gold at the kinetic energies E/sub 4(sub He)/=1.3-13.5 GeV have been measured. Charge yields are approximated by $\sigma(Z) \sim Z/\sup -r/$ dependence. The nature of minimum in r(E/sub 4(sub He)/)-dependence at E/sub 4(sub He)/ ~ 6 GeV is discussed. 11 refs.; 3 figs.

44249 **Levels of the four lowest two-particle configurations in /sup 210/Po studied by in-beam γ-ray and conversion-electron spectroscopy with the /sup 209/Bi(t,2n) reaction.** Mann, L.G.; Maier, K.H.; Aprahamian, A.; Becker, J.A.; Decman, D.J.; Henry, E.A.; Meyer, R.A.; Roy, N.; Stoeffl, W.; Struble, G.L.; and others. (Lawrence Livermore National Laboratory, Livermore, California 94550). *Physical Review [Section] C: Nuclear Physics;* **38**: No. 1, 74-91(Jul 1988).

We have used the /sup 209/Bi(t,2n)/sup 210/Po reaction with standard in-beam γ-ray and conversion-electron spectroscopic techniques to study the two-proton states in /sup 210/Po. With the possible exception of the (f/sub 7/2/²)/sub =/, all states of the proton h/sub 9/2/², h/sub 9/2/f/sub 7/2/, f/sub 7/2/², and h/sub 9/2/i/sub 13/2/ configurations have been identified. The level energies agree within 100 keV, typically, with results from shell-model calculations. Relative intensities of M1 and E2 γ transitions from the h/sub 9/2/f/sub 7/2/ and f/sub 7/2/² configurations are compared with calculated intensities. Published experimental single-proton transition matrix elements were used for the calculations, which were performed both for pure and for mixed states. The results indicate admixture amplitudes of only a few percent or less into the main components of the wave functions.

6520 Nuclear Properties And Reactions, A=220 And Above, Experimental

44250 **(CONF-8806117—5) Nuclear stopping in oxygen-induced reactions at 200 A GeV.** Obenshain, F.E.; Albrecht, R.; Awes, T.C.; Baktash, C.; Beckmann, P.; Berger, F.; Bock, R.; Claesson, G.; Dragon, L.; Ferguson, R.L. (Oak Ridge National Lab., TN (USA)). 1988. Contract AC05-84OR21400. 9p. NTIS, PC A02/MF A01; 1; GPO Dep. Order Number DE88012494/JAW.

From 3. international conference on nucleus nucleus collisions; Saint-Malo, France (6 Jun 1988).

A primary goal of relativistic heavy-ion studies is to verify the existence of the postulated quark-gluon plasma (QGP). Since most of the possible plasma signatures are indistinguishable from background created by nonplasma events. Thorough understanding of reaction mechanisms is an important prerequisite in any QGP search. To isolate collective features of nucleus-nucleus collisions from those that may be expected on the basis of linear superposition of nucleon-nucleus collisions, we compare measured quantities with calculations that reproduce data from nucleon-induced reactions and that make predictions for nucleus-nucleus reactions. Here we discuss the data obtained from our Zero-Degree Calorimeter (ZDC) and the transverse energy obtained from the Mid-Rapidity Calorimeter (MIRAC). The primary reactions considered are: $^{16}O + {}^{12}C$ and $^{16}O + {}^{197}Au$. The measurements show a high degree of nuclear stopping and the energy densities may be large enough to produce a transition to the quark-gluon plasma. 10 refs., 5 figs.

44251 **(INIS-mf—11114, pp 12-24) Mean-square radius changes of the ^{235}U nucleus by resonance neutron capture.** Mittag, S.; Pabst, D.; Pikelner, L.B.; Pilz, W.; Tschammer, R.; Meister, A.; Seeliger, D.; Seidel, K. (Joint Inst. for Nuclear Research, Dubna (USSR). Lab. of Neutron Physics; Technische Univ., Dresden (German Democratic Republic). Sektion Physik). 1984. NTIS (US Sales Only), PC A10/MF A01. Order Number DE88701749/JAW. (CONF-8309169—).

From 15. international summer school in nuclear physics; Mikolajki, Poland (5 Sep 1983).

Chemically induced shifts of low energetic neutron resonances of ^{235}U were determined from transmission spectra measured at the Dubna pulsed reactor. The shifts are interpreted as changes of the mean-square radius of the nucleus capturing the neutron. The $\langle r^2 \rangle$ of the compound nucleus states show in the average a weak diminution compared with the ground state value and a correlation with the fission width. From this, the dependence of admixture of second well configurations on the fission width is estimated.

44252 **N/Z equilibration in damped collisions induced by E/A = 8.5 MeV /sup 58/Ni and /sup 64/Ni on /sup 238/U.** Planeta, R.; Zhou, S.H.; Kwiatkowski, K.; Wilson, W.G.; Viola, V.E.; Breuer, H.; Benton, D.; Khazaie, F.; McDonald, R.J.; Mignerey, A.C.; and others. (Department of Chemistry and Indiana University Cyclotron Facility, Indiana University, Bloomington, Indiana 47405). *Physical Review [Section] C: Nuclear Physics;* **38**: No. 1, 195-209(Jul 1988).

Nuclide distributions have been measured for damped collision products formed in the reaction of E/A = 8.5 MeV /sup 58/Ni and /sup 64/Ni ions with /sup 238/U. The data demonstrate that in these very asymmetric systems the evolution of the nucleon-exchange process as a function of energy loss depends strongly on the N/Z value of the projectile and the corresponding gradient in the potential-energy surface. Comparison of the data with transport model calculations shows qualitative agreement with the N and Z centroids, variances, and correlation coefficients. However, absolute discrepancies exist which suggest the need for improvement in the model.

44253 **Possibility of pions emitted in the spontaneous fission of /sup 252/Cf.** Beene, J.R.; Bemis C.E. Jr.; Halbert, M.L. (Physics Division, Oak Ridge National Laboratory, Oak Ridge, Tennessee 37831). *Physical Review [Section] C: Nuclear Physics;* **38**: No. 1, 569-571(Jul 1988).

We have performed a search for spontaneous fission of /sup 252/Cf accompanied by neutral pions. We have placed an upper limit of one such decay per 10^9 fissions at the 90% confidence level.

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REFER ALSO TO CITATION(S) 44059, 44109, 44199, 44200, 44200, 44218, 44518

44254 **(ANL-PHY—88-2) Proceedings of the conference on high-spin nuclear structure and novel nuclear shapes.** (Argonne National Lab., IL (USA)). 1988. Contract W-31109-ENG-38. 317p. (CONF-880496—). NTIS, PC A15. Order Number DE88013968/JAW.

From Conference on high-spin nuclear structure and novel nuclear shapes; Argonne, IL, USA (13 Apr 1988).

This paper contains the proceedings of the conference on High-Spin Nuclear Structure and Novel Nuclear Shapes. The major topic covered are: Superdeformation, Octupole deformation, Quasicontinuum structure, Hot nuclei, and Structure near the yrast line. (LSP)

44255 **(FEI—1860) On microscopic description of heated nuclei.** Kamerdzhiev, S.P. (Gosudarstvennyj Komitet po Ispol'zovaniyu Atomnoj Ehnergii SSSR, Obninsk. Fiziko-Ehnergeticheskij Inst.). 1987. 15p. (In Russian). NTIS (US Sales Only), PC A03/MF A01. Order Number DE88703496/JAW.

The method of temperature Green functions is used in case of Tnot =0 temperature of two microscopic approaches: the standard theory of fermi-systems with full estimation of particle-particle interactions, early developed variant of microscopic model of complex configurations estimation in magic nuclei. The basic equations of these approaches are estimated for Tnot =0,that allows to use sequence microscopic description of levels characteristics in nuclei 'heated' up to E≦100 MeV (T≦2-3MeV) energy. 16 refs.; 2 figs.

44256 **(IC—88/48) Folding model analysis of Λ binding energies and three-body ΛNN force.** Mian, M.; Ahmad, I.; Rahman Khan, M.Z. (Guru Nanak Dev Univ., Amritsar (India). Dept. of Physics; International Centre for Theoretical Physics, Trieste (Italy); Aligarh Muslim Univ. (India). Dept. of Physics). (International Centre for Theoretical Physics, Trieste (Italy)). Feb 1988. 11p. NTIS (US Sales Only), PC A03/MF A01. Order Number DE88703531/JAW.

Working within the framework of the folding model, we analyze the Λ binding energy data of light hypernuclei with effective two-body ΛN plus three-body ΛNN interaction. The two-body density for the core nucleus required for evaluating the three-body force contribution is obtained in terms of the centre of mass pair correlation. It is found that except for /sub Λ//sup 5/He the data are fairly well explained. The three-body force seems to account for the density dependence of the effective two-body ΛN interaction proposed earlier. (author). 13 refs, 2 tabs.

44257 **(INIS-BR—991) Delayed β ray spectrum of /sup 235/U fission fragments.** Pascholati, P.R. (Centro Brasileiro de Pesquisas Fisicas, Rio de Janeiro). 1973. 79p. (In Portuguese). NTIS (US Sales Only), PC A05/MF A01. Order Number DE88702575/JAW.

The time-dependent electron spectra of fission fragments from the thermal-neutron-induced fission of /sup 235/U are calculated. The Gross theory of nuclear beta decay is used to obtain the decay constant and individual electron spectra. The mean energy per fission carried by the electrons and the number of electrons per fission are also calculated. Comparison of these calculated spectra to experimental ones shows good agreements.

44258 (INIS-mf—11114, pp 1-11) **^{3}He charge form factor: a simple, explicit formula.** Bartnik, E.A.; Haberzettl, H.; Sandhas, W. (Bonn Univ. (Germany, F.R.). Physikalisches Inst.). 1984. NTIS (US Sales Only), PC A10/MF A01. Order Number DE88701749/JAW. (CONF-8309169—).

From 15. international summer school in nuclear physics; Mikolajki, Poland (5 Sep 1983).

An approximate formula for the charge form factor of ^{3}He, which is applicable for values of the squared momentum transfer larger than 6 fm^{-2} is derived. Our result explicitly expresses the form factor in a very simple and direct way by the underlying two-body potentials.

44259 (INIS-mf—11114, pp 158-171) **Merging: what discriminates quasi-elastic from deep-inelastic processes.** Brosa, U.; Westmeier, W. (Marburg Univ. (Germany, F.R.). Fachbereich 13 Physik). 1984. NTIS (US Sales Only), PC A10/MF A01. Order Number DE88701749/JAW. (CONF-8309169—).

From 15. international summer school in nuclear physics; Mikolajki, Poland (5 Sep 1983).

Theoretical reasoning and experimental data both reveal the qualitative difference between quasi-elastic and deep-inelastic reactions. A dynamic instability, which we call merging, separates the two modes. We suggest a simple model to calculate the characteristic time of merging, compute quasi-elastic reaction cross sections and compare them with experimental results.

44260 (INIS-mf—11114, pp 193-200) **On the temperature difference driven fluxes in dissipative collisions.** Matulewicz, T.; Gobbi, A.; Toeke, J. (Warsaw Univ. (Poland). Inst. Fizyki Doswiadczalnej; Gesellschaft fuer Schwerionenforschung m.b.H., Darmstadt (Germany, F.R.)). 1984. NTIS (US Sales Only), PC A10/MF A01. Order Number DE88701749/JAW. (CONF-8309169—).

From 15. international summer school in nuclear physics; Mikolajki, Poland (5 Sep 1983).

The results are presented of the random-walk simulations of the dissipative collision process where the temperatures as well as the numbers of nucleons of both colliding nuclei have been followed. It has been assumed that it is the particle exchange which is responsible for the energy dissipation. The branching probabilities for the transfers in either of two directions in the mass asymmetry degree of freedom as well as the expected excitation deposits in both nuclei have been evaluated. (M.F.W.).

44261 (INIS-mf—11114, pp 201-211) **Angular momentum dissipation in heavy-ion collisions within a microscopic approach based on the DTHF-approximation.** Janssen, D.; Militzer, M.; Reif, R. (Technische Univ., Dresden (German Democratic Republic). Sektion Physik). 1984. NTIS (US Sales Only), PC A10/MF A01. Order Number DE88701749/JAW. (CONF-8309169—).

From 15. international summer school in nuclear physics; Mikolajki, Poland (5 Sep 1983).

Starting from the TDHF-approximation, equations of motion for the single particle density matrices refering to projectile and target are derived in a translating and rotating reference frame. An expansion of the fluctuating part of the transformed density in terms of RPA modes in the ph as well as the pp(hh) channel leads to a system of non-linear, coupled equations which simultaneously determine the time development of the collective coordinates and momenta of the relative motion, of the intrinsic angular momentum and of the amplitudes of coherent surface excitations of the fragments. The formalism is applied for the angular momentum dissipation in the excitation of damped dipole modes.

44262 **(ISN—87-82) Multiphonon method applied to vibrational (K=O) state study in deformed heavy nuclei.** Leandri, J. (Grenoble-1 Univ., 38 (France). Inst. des Sciences Nucleaires). Oct 1987. 187p. (In French). NTIS (US Sales Only), PC A09/MF A01. Order Number DE88754061/JAW.

An explicit formulation of the multiphonon method is given where two phonons are introduced as base. Vibrational states can then be studied in the realistic case of pair deformed heavy-nuclei (plutonium, uranium and thorium isotopes). Localization and properties of two-phonon states are particularly examined. Energy spectra are systematically dilated, octupolar vibrations K=O/sup -/ show more anharmonicity than the K=O/sup +/ ones. The two-phonon states are between 1.7 and 2 MeV; they keep a collective nature by their electromagnetic transitions (E1, E2, E3) towards one-phonon states.

44263 **(ITEF—157(1987)) New variables for description of cumulative particle production.** Gerzon, S.A.; Kiselev, Yu.T.; Semenov, S.V. (Gosudarstvennyj Komitet po Ispol'zovaniyu Atomnoj Ehnergii SSSR, Moscow. Inst. Teoreticheskoj i Ehksperimental'noj Fiziki). 1987. 16p. (In Russian). NTIS (US Sales Only), PC A03/MF A01. Order Number DE88703598/JAW.

Variables permitting to describe a great number of data collection on cumulative particle production cross sections in aA->bX reactions are suggested. Spectra of cumulative pions, kaons, protons, deuterons and tritons from the PI/sup +/ + Pb, PI/sup +/ + C, p + Ta, p + Be, p + Al reactions are presented. 14 refs.; 10 figs.

44264 **(ITEP—174(1987)) Diffractive scattering of nuclei in the multiple scattering theory with inelastic screening.** Zoller, V.R. (Gosudarstvennyj Komitet po Ispol'zovaniyu Atomnoj Ehnergii SSSR, Moscow. Inst. Teoreticheskoj i Ehksperimental'noj Fiziki). 1987. 17p. NTIS (US Sales Only), PC A03/MF A01. Order Number DE88703620/JAW.

The Glauber-Gribov model for hadron-nucleus scattering is extended to multiproduction processes by supplementing it with the Abramoviski-Gribov-Kancheli cutting rules. In contrast to the standard Glauber approach neither smallness of the interaction radius compared to the nuclear radii non-Gaussian form of the hN-

interaction profile function are assumed. The theory of supercritical Pomeron is used. However all the results are more general and do not depend on the specific parametrization of the Pomeron pole amplitude. The interelestic screening due to the low mass diffractive excitation is also included. The cross sections of coherent and incoherent diffractive production of the low mass hadronic states are calculated. 20 refs.; 1 fig.

44265 **(ITEP—176(1987)) Nucleus-nucleus scattering in the Glauber approach.** Boreskov, K.G.; Kajdalov, A.B. (Gosudarstvennyj Komitet po Ispol'zovaniyu Atomnoj Ehnergii SSSR, Moscow. Inst. Teoreticheskoj i Ehksperimental'noj Fiziki). 1987. 25p. NTIS (US Sales Only), PC A03/MF A01. Order Number DE88703621/JAW.

An analysis of the scattering of two composite objects is carried out in the Glauber approach. A formal solution of this problem is obtained in a form of density expansion. The first term of this expansion, corresponding to summation of all graphs without loops, leads to the optical approximation formula obtained earlier by summing a more limited class of graphs. For realistic nuclear densities all terms of the series are important and its convergence requires a special analysis. It is pointed out that this problem is equivalent to the problem of calculation of the partition function of mixture of two-dimensional liquids with nondiagonal interaction. The phase transition, which takes place in this system at large densities, confirms the conclusion that the virial expansion is not valid for nuclear densities. 14 refs.; 7 figs.

44266 **(ITEP—196(1987)) Testing the QCB potentials in the three-nucleon system.** Grach, I.L.; Narodetskij, I.M.; Yurov, V.P. (Gosudarstvennyj Komitet po Ispol'zovaniyu Atomnoj Ehnergii SSSR, Moscow. Inst. Teoreticheskoj i Ehksperimental'noj Fiziki). 1987. 13p. NTIS (US Sales Only), PC A03/MF A01. Order Number DE88703625/JAW.

The triton binding energy E/sub T/ is calculated for the quark compound bag model NN potentials including tensor force with the use of the truncated approximation for the /sup 3/S/sub 1/-/sup 3/D/sub 1/ T-matrix in the Faddeev kernel. The results are in qualitative agreement with the experimental value of E/sub T/. 11 refs.

44267 **(JINR-E—1-87-740) Whether it is possible to pump energy into atomic nuclei by high energy hadronic or nuclear projectiles.** Strugalski, Z. (Joint Inst. for Nuclear Research, Dubna (USSR). Lab. of High Energy). 1987. 9p. NTIS (US Sales Only), PC A02/MF A01. Order Number DE88703679/JAW.

In this paper, it is discussed whether it is possible to pump energy into atomic nuclei by high energy hadronic or nuclear projectiles. The discussion is performed on the purely experimental ground, without application of models. The conditions are considered at which quagma might be obtained in hadron-nucleus and nucleus-nucleus collisions. 28 refs.; 1 tab.

44268 **(JINR-E—2-87-287) Next-to-leading order QCD-analysis of EMC deep inelastic μp and μd scattering data.** Bilen'kaya, S.I.; Stamenov, D.B. (Joint Inst. for Nuclear Research, Dubna (USSR). Lab. of Theoretical Physics). 1987. 16p. NTIS (US Sales Only), PC A03/MF A01. Order Number DE88703681/JAW.

Submitted to the journal Nucl. Phys., B.

A combined next-to-leading order QCD analysis of the European Muon Collaboration (EMC) μH/sub 2/ and μD/sub 2/ scattering data is presented. The nucleon structure functions are given in terms of parton distributions. The Buras-Gaemers method is used to solve the QCD equations for these distributions. The higher twist corrections are not taken into account. As has been shown their contribution to the structure functions is negligible in the EMC kinematic region. Unlike most of the papers on this subject the cross section data (not the value for the structure functions obtained from these data by additional extrapolations and assumptions) are fitted. the following values for the QCD scale parameter Λ/sub MS-bar/ are found: Λ/sub MS-bar/=218 +-73 MeV for the non-singlet fit to the data in the range x>0.3 and Λ/sub MS-bar/ =65+-20 MeV if the whole x data are fitted. 16 refs.; 2 tabs.

44269 **(JINR-E—4-87-475) Semiclassical treatment of a realistic nuclear avoided level-crossing problem.** Milek, B.; Reif, R. (Joint Inst. for Nuclear Research, Dubna (USSR). Lab. of Theoretical Physics; Technische Univ., Dresden (German Democratic Republic). Sektion Physik). (Joint Inst. for Nuclear Research, Dubna (USSR). Lab. of Theoretical Physics). 1987. 16p. NTIS (US Sales Only), PC A03/MF A01. Order Number DE88703692/JAW.

For a heavy-ion collision a nuclear two-state problem referring to an avoided level crossing of adiabatic single-particle states of the same symmetry is treated semiclassically within a two-center shell model with finite-depth mean potentials. Using a realistic trajectory for the relative motion and a realistic time-dependent coupling strength, numerical results for the one-way and two-way jump probabilities are presented for the transition /sup 13/C(/sup 17/O, /sup 17/O/sup */)/sup 13/C, 1d5/2->2s1/2 (Ω=1/2). The results are not in agreement with the predictions of the Landau-Zener formula, but confirm some properties of extended analytical treatments of the avoided level-crossing problem. 27 refs.; 5 figs.

44270 **(JINR-E—4-87-579) On the quasiparticle-phonon nuclear model at finite temperature.** Nazmitdinov, R.G.; Rybarska-Nawrocka, W. (Tashkentskij Gosudarstvennyj Univ. (USSR)). (Joint Inst. for Nuclear Research, Dubna (USSR). Lab. of Theoretical Physics). 1987. 12p. NTIS (US Sales Only), PC A03/MF A01. Order Number DE88703693/JAW.

The system of equations for the parameters describing the quasiparticle and phonon excitations in nucleus is obtained from the unique variational principle for the thermodynamic potential. Quasiparticle-phonon interaction is taken into account perturbatively in the first nonzero approximation. 13 refs.

44271 **(JINR-E—4-87-748) Electron scattering from /sup 20/Ne and /sup 24/Mg in a microscopic boson model.** Kuchta, R. (Joint Inst. for Nuclear Research, Dubna (USSR). Lab. of Theoretical Physics). 1987. 9p. NTIS (US Sales Only), PC A02/MF A01. Order Number DE88703695/JAW.

It is shown that a mean-field approximation applied to the microscopically derived boson Hamiltonian yields a reasonable description of the form factors for both elastic and inelastic electron scattering from some sd-shell nuclei (/sup 20/Ne, /sup 24/Mg). The results agree well with experimental data for the 0/sup +/ -> 0/sup +/ and 0/sup +/ -> 2/sup +/ transitions but much less so for the 0/sup +/ -> 4/sup +/ transitions. Possible sources of the observed discrepancies are suggested. 20 refs.; 4 figs.; 1 tab.

44272 **(JINR-R—2-87-320) Polarization effects in scattering of arbitrary spin particles with noncollinear monients.** Golovin, B.M. (Joint Inst. for Nuclear Research, Dubna (USSR). Lab. of Nuclear Problems). 1987. 4p. (In Russian). NTIS (US Sales Only), PC A02/MF A01. Order Number DE88703726/JAW.

Submitted to the Organizing Committee of the 5. All-Union seminar Programme of experimental investigations on meson factory JNR of Academy of Sciences of USSR, Zvenigorod, 1987.

It is shown that the collisions of arbitrary spin particles with noncollinear moments give rise to some polarization effects which are not observed in the case of the rest targets. All these phenomena are due to kinematics. They can be observed at quasi-free scattering of beam particles on intra-nuclear nucleons or nuclear clasters. The comparison of the experimental data with predicted polarization effects can be used for picking out the kinematic region where the pole diagram is predominent. 4 refs.

44273 **(JINR-R—2-87-789) Intranuclear cascade model taking into account time coordinate and many-particle interactions.** Barashenkov, V.S.; Kostenko, B.F. (Joint Inst. for Nuclear Research, Dubna (USSR). Lab. of Computing Techniques and Automation). 1987. 8p. (In Russian). NTIS (US Sales Only), PC A02/MF A01. Order Number DE88703738/JAW.

The flowchart and principal stages of calculating the hadron intranuclear cascade initiated by high energy nucleon or meson is

discussed. Contribution of many-particle interactions when one nucleon interacts with several cascade particles simultaneously is considered. Calculation is performed taking into account both spatial and time coordinates in explicit form. 16 refs.; 5 figs.

44274 **(KIYI—87-20) Diffraction dissociation of nuclei on non-spherical deformed nuclei.** Evlanov, M.V.; Isupov, V.Yu.; Tartakovskij, V.K. (AN Ukrainskoj SSR, Kiev. Inst. Yadernykh Issledovanij). 1987. 30p. (In Russian). NTIS (US Sales Only), PC A03/MF A01. Order Number DE88703798/JAW.

General expressions for differential cross sections of the two-fragment diffraction disintegration of nuclei in the field of non-spherical nuclei are obtained. The angular and energy distributions of products of the breaking reaction of incident deuterons and /sup 3/He nuclei are calculated depending on the parameters of general deformation of nucleus, its nonaxiality and deformability. The calculations are carried out in the two cases when target-nucleus remains in the ground state or transits in the first excited collective state. It is found that the shape and softness of nucleus essentially effect the breakup process of incident compozite particle. Results show the importance of the rescattering effect in processes of the diffraction disoociation of nuclei. 26 refs.; 14 figs.

44275 **Convection currents in nuclei in a relativistic mean-field theory.** Furnstahl, R.J. (Physics Department and Nuclear Theory Center, Indiana University, Bloomington, Indiana 47405). *Physical Review* [*Section*] *C: Nuclear Physics;* **38**: No. 1, 370-385(Jul 1988).

Isoscalar convection currents for nuclei with one valence particle or hole outside a closed-shell core are studied in the mean-field (Hartree) approximation to the Walecka model. The currents are constructed using nucleon wave functions computed in the self-consistent potentials of the spherical core. Approximate self-consistency for the full odd-A nucleus is imposed by using linear response theory to correct the core wave functions for the effects of the valence nucleon. At low q, this core response cancels the enhancement of the isoscalar current that arises from the reduced effective mass of the valence nucleon so that magnetic moments are close to the Schmidt predictions. In contrast, particle-hole mixing in the core response enhances the single-particle current further at higher q. Calculations of magnetic moments and elastic magnetic scattering in light nuclei are presented to illustrate these results. The relationship of these calculations to fully self-consistent mean-field solutions of odd-A nuclei and to the linear response function in nuclear matter is discussed.

44276 **Optimal parametrization for the relativistic mean-field model of the nucleus.** Rufa, M.; Reinhard, P.; Maruhn, J.A.; Greiner, W.; Strayer, M.R. (Institut fuer Theoretische Physik, Universitaet Frankfurt, D-6000 Frankfurt am Main, Federal Republic of Germany). *Physical Review* [*Section*] *C: Nuclear Physics;* **38**: No. 1, 390-409(Jul 1988).

We study a relativistic model of the nucleus consisting of nucleons coupled to mesonic degrees of freedom via an effective Lagrangian whose parameters are determined by a fit to selected nuclear ground-state data. We find that the model allows a very good description of nuclear ground-state properties. Because of the relativistic nature of the model, the spin properties are uniquely fixed. We discuss variations of the parametrization and of the data which suggest that the present fit has exhausted the limits of the mean-field approximation, and discuss extensions which go beyond the mean field.

44277 **Calculations of many-particle—many-hole deformed state energies: Near degeneracies, deformation condensates.** Zheng, D.C.; Berdichevsky, D.; Zamick, L. (Department of Physics and Astronomy, Rutgers University, Piscataway, New Jersey 08855). *Physical Review* [*Section*] *C: Nuclear Physics;* **38**: No. 1, 437-443(Jul 1988).

In deformed Hartree-Fock calculations with Skyrme interactions we observe a near degeneracy of the mean energies of many-particle—many-hole deformed intrinsic states. For example, in /sup 40/Ca the np-nh states with n = 2, 3, 4, 5, 6, 7, and 8 are nearly degenerate. The deformation parameter β increases steadily from n = 2 to 8. The intrinsic state energy of the 8p-8h state is lower than that of the 4p-4h state for the interactions used here: SK III, SK IV, and SK VI. The calculations are also performed with the Skyrme III interaction for the even-even calcium and titanium isotopes. For /sup 44/Ti there is a near degeneracy of 6p-2h and 8p-4h. For the N>Z isotopes above, the two protons excitation lies lowest. Whereas the intrinsic state energies are much higher than the observed energies of the lowest-lying deformed states, the results when projection of $J = 0^+$ states is carried out and pairing effects are taken into account, are encouraging.

44278 **Interpretation of atomic mass systematics in terms of the valence shells and a simple scheme for predicting masses.** Haustein, P.E.; Brenner, D.S.; Casten, R.F. (Brookhaven National Laboratory, Upton, New York 11973 Clark University, Worcester, Massachusetts 01610). *Physical Review* [*Section*] *C: Nuclear Physics;* **38**: No. 1, 467-470(Jul 1988).

A new semiempirical method that significantly simplifies atomic mass systematics and which provides a method for making mass predictions by linear interpolation is discussed in the context of the nuclear valence space. In certain regions complicated patterns of mass systematics in traditional plots versus Z, N, or isospin are consolidated and transformed into linear ones extending over long isotopic and isotonic sequences.

44279 **Ground-state energy of nuclear matter.** Baker G.A. Jr.; Benofy, L.P.; Fortes, M. (Theoretical Division, Los Alamos National Laboratory, University of California, Los Alamos, New Mexico 87545). *Physical Review* [*Section*] *C: Nuclear Physics;* **38**: No. 1, 329-337(Jul 1988).

The low-density expansion of the ground-state energy for spin-dependent forces is given, through order k/sub F/^{6} for the ladder approximation and through order k/sub F/^{6}lnk/sub F/ for the complete energy, in terms of derivatives with respect to the strength of the attractive part of the interaction defined by the Baker-Hind-Kahane potential. The ladder approximation is also computed by the numerical solution of the K-matrix equation. The resulting series gives a satisfactory representation of the energy at interesting densities. Using Pade extrapolation techniques, both in the density and in the attractive part of the interaction, we obtain the ground-state energy of nuclear matter.

44280 **Bipolar harmonic reduction formulae.** Friar, J.L.; Payne, G.L. (Theoretical Division, Los Alamos National Laboratory, Los Alamos, New Mexico 87545). *Physical Review* [*Section*] *C: Nuclear Physics;* **38**: No. 1, 1-4(Jul 1988).

Bipolar harmonics are bilinear products of spherical harmonics with different arguments coupled to total angular momentum L; they are frequently used in nuclear physics. We present analytic mappings of these harmonics for $L \leq 3$ onto an irreducible basis, as well as a discussion of their properties. Mappings of lower order have proven very useful recently in treating deuteron photo- disintegration and in solving the Faddeev equations for the triton.

44281 **Damping of the continuum response from 2p-2h excitations.** Smith, R.D.; Wambach, J. (Los Alamos National Laboratory, Los Alamos, New Mexico 87545). *Physical Review* [*Section*] *C: Nuclear Physics;* **38**: No. 1, 100-108(Jul 1988).

The nuclear response function in the random-phase-approximation theory may be substantially altered at high excitation energy due to coupling of 1p-1h to 2p-2h or higher excitations. In the continuum region of quasi-elastic scattering, this coupling can be included by inserting into the random-phase-approximation Green's function a complex self-energy for the p-h states, which depends only on their energy, spin (S), and isospin (T). This allows the full response to be expressed directly as an integral over the random-phase-approximation response. The self-energies, which can be determined from empirical single-particle spreading widths, are large in the spin and isospin channels, but small in the T,S = 0,0 channel, giving rise to substantial damping in all channels except 0,0. We apply this method to calculate damping of the random-phase-approximation surface response, and discuss the consequences for cross sections and spin observables in quasi-elastic (p,p') and (n,p) reactions.

44282 **Effect of surface fluctuations on the nuclear density.** Johnson, M.B.; Wenes, G. (Los Alamos Meson Physics Facility and Theoretical Division, Los Alamos National Laboratory, Los Alamos, New Mexico 87545). *Physical Review [Section] C: Nuclear Physics;* **38**: No. 1, 386-389(Jul 1988).

We show that the reliability of theoretical estimates of the admixture of collective zero-point fluctuations in the nuclear ground state is currently limited by uncertainties in the effective nucleon-nucleon interaction and the existence of double-counting corrections arising from various sources. The issues are illustrated in a model calculation that includes some of the corrections and we find results that are considerably smaller than those recently reported in the literature. Pion scattering is suggested as an appropriate tool for experimentally constraining theoretical uncertainties in these pieces of the density.

44283 **Some puzzling results in measuring the reaction rate of D/sub 2/+T/sub 2/ → 2DT.** McConville, G.T.; Menke, D.A.; Ellefson, R.E. (Monsanto Research Corp.-Mound (US)). pp 17 of Contributions to the muon catalyzed fusion workshop. Idaho Falls, ID; Idaho National Engineering Lab. (1985). (CONF-840660—).

From Workshop on muon-catalyzed fusion reactions; Jackson, WY, USA (7 Jun 1984).

Reaction rates for the formation of DT have been measured in a 304 stainless steel reaction container produced and treated to produce a Fe depleted surface which inhibits protium ingrowth. The rate has been measured as a function of initial T/sub 2/ concentration and temperatures using T/sub 2/ and D/sub 2/ with less than 30 ppm of any observed impurity concentrations and with concentrations of CT/sub 4/ up to several hundred ppm. At room temperature the rate increases linearly with increasing T/sub 2/ concentration containing 100 ppm CT/sub 4/ inhibitor but very much more rapidly with T/sub 2/ containing <30 ppm CT/sub 4/. The decrease in rate with increasing CT/sub 4/ concentration is consistent with an ion molecule chain reaction for the production of DT. The temperature dependence of 30% initial T/sub 2/ mixtures displays a resonance in the reaction rate between 160 and 210K. the temperature resonance and very fast rates with pure initial T/sub 2/ concentrations indicate that reactions with excited state molecules are affecting the results. Some preliminary measurements in the presence of a —500 Gauss magnet point to the fact that surface interactions must also be considered for this container.

44284 **Calculations of muon capture in D/sub 2//T/sub 2//He mixtures.** Cohen, J.S. (Theoretical Div., Los Alamos National Lab., Los Alamos, NM (US)). pp 75-89 of Contributions to the muon catalyzed fusion workshop. Idaho Falls, ID; Idaho National Engineering Lab. (1985). (CONF-840660—).

From Workshop on muon-catalyzed fusion reactions; Jackson, WY, USA (7 Jun 1984).

The first step in the muon-catalyzed fusion cycle is slowing down and capture of the negative muon in isotopic hydrogen mixtures. The authors used two methods for calculating this process: the classical-trajectory Monte Carlo (CTMC) approach and the diabatic-state model. Previous CTMC calculations probably give the most accurate published cross sections for μ- capture by hydrogen isotopes. However, those results are somewhat uncertain since, while the momentum distribution in the H-atom is given exactly, the position distribution is not described well by the microcanonical ensemble employed. A description has now been developed that simultaneously treats the position and the momentum distributions with sufficient accuracy. As the amount of helium in the mixture builds up (/sup 3/He from tritium decay or /sup 4/He from fusion), the catalytic action is poisoned. Cross sections for μ-capture by He have also been calculated. Determination of the fraction captured by He requires, in addition, proper description of the muon-energy transport. Results for hydrogen/helium mixtures are presented and the tolerable contamination by He deduced.

44285 **α - sticking probability.** Morgan. (Lawrence Livermore National Lab., Livermore, CA (US)). pp 109-111 of Contributions to the muon catalyzed fusion workshop. Idaho Falls, ID; Idaho National Engineering Lab. (1985). (CONF-840660—).

From Workshop on muon-catalyzed fusion reactions; Jackson, WY, USA (7 Jun 1984).

The possibility that the muon may become bound to the α in d+t+μ/sup -/ → n+α+μ/sup -/ limits the number of times the μ/sup -/ can catalyze d-t fusion. Hence the importance of calculating the α-sticking probability (W/sub s/). The authors have just begun the calculation of W/sub s/. They describe the methods they are considering using and some preliminary results.

6540 Radiation And Shielding Physics

REFER ALSO TO CITATION(S) 43126, 43127, 43496, 43744

44286 (INIS-mf—11210, pp V4-V7) **Introducing NOXER-A 3D nodal diffusion code.** Segev, M. (CEA Centre d'Etudes Nucleaires de Saclay, 91 - Gif-sur-Yvette (France)). Dec 1987. NTIS (US Sales Only), PC A13/MF A01. Order Number DE88780087/JAW. (CONF-871287—).

From Nuclear Societies of Israel annual meeting; Haifa, Israel (21 Dec 1987).
Transactions.; V. 14.

44287 (INIS-mf—11210, pp V16-V20) **Impact of P/sub n/ approximation in calculations of transfer cross sections and scalar fluxes for anisotropic scattering of D-T neutrons in graphite.** Ofek, R.; Tsechanski, A.; Shani, G. (Ben-Gurion Univ. of the Negev, Beersheba (Israel). Dept. of Nuclear Engineering). Dec 1987. NTIS (US Sales Only), PC A13/MF A01. Order Number DE88780087/JAW. (CONF-871287—).

From Nuclear Societies of Israel annual meeting; Haifa, Israel (21 Dec 1987).
Transactions.; V. 14.

44288 (INIS-mf—11210, pp V33-V37) **Direct thermal neutron capture in Mg isotopes.** Kahane, S.; Raman, S.; Lynn, J.E. (Oak Ridge National Lab., TN (USA); Israel Atomic Energy Commission, Beersheba. Nuclear Research Center-Negev; Oak Ridge National Lab., TN (USA); Los Alamos National Lab., NM (USA)). Dec 1987. NTIS (US Sales Only), PC A13/MF A01. Order Number DE88780087/JAW. (CONF-871287—).

From Nuclear Societies of Israel annual meeting; Haifa, Israel (21 Dec 1987).
Transactions.; V. 14.

44289 (INIS-mf—11210, pp V38-V41) **Pressure vessel fluence reduction possibilities using effective shielding reflectors.** Shayer, Z.; Greenspan, E. (Israel Atomic Energy Commission, Tel Aviv). Dec 1987. NTIS (US Sales Only), PC A13/MF A01. Order Number DE88780087/JAW. (CONF-871287—).

From Nuclear Societies of Israel annual meeting; Haifa, Israel (21 Dec 1987).
Transactions.; V. 14.

44290 (INIS-mf—11210, pp V45-V64) **Shielding benchmarks.** Celnik, J. (Stone and Webster Engineering Corp., New York (USA)). Dec 1987. NTIS (US Sales Only), PC A13/MF A01. Order Number DE88780087/JAW. (CONF-871287—).

From Nuclear Societies of Israel annual meeting; Haifa, Israel (21 Dec 1987).
Transactions.; V. 14.

44291 (ITEF—46(1987)) **On the reduction of neutron transport theory boundary problems to singular integral equations.** Abramov, B.D.; Matveev, A.F. (Gosudarstvennyj Komitet po Ispol'zovaniyu Atomnoj Ehnergii SSSR, Moscow. Inst. Teoreticheskoj i Ehksperimental'noj Fiziki). 1987. 32p. (In Russian). NTIS (US Sales Only), PC A03/MF A01. Order Number DE88703593/JAW.

Approaches to solving neutron, γ-quanta, etc. transport theory boundary problems by reducing them to singular integral equations are discussed. The known reduction methods of the

boundary problems investigated and the methods of the approximate solution of singular integral equations are reviewed. 75 refs.

44292 **(JINR-R—3-87-408) Measurement of ultracold neutron reflection from the surface of samples with large capture cross section.** Novopol'tsev, M.I.; Pokotilovskij, Yu.N. (Mordovskij Gosudarstvennyj Univ., Saransk (USSR)). (Joint Inst. for Nuclear Research, Dubna (USSR). Lab. of Neutron Physics). 1987. 7p. (In Russian). NTIS (US Sales Only), PC A02/MF A01. Order Number DE88703741/JAW.

The energy dependence of reflection coefficient of ultra-cold neutrons from /sup 113/Cd and /sup 155/Gd strongly absorbing element surface is measured. Samples were prepared by the method of thermal evaporation in vacuum directly in neutron beam. The spectra of reflected neutrons were measured with the correlation type of time-of-flight spectrometer. In the /sup 155/Gd case for which real part of the interaction potential is much lesser than the imaginary part, the effect of "metallic" reflection of neutrons is observed. 12 refs.; 4 figs.

44293 **(JINR-R—3-87-578) Time-of-flight spectrometry of ultracold neutrons on the basis of thin-film ferromagnetic chopper.** Novopol'tsev, M.I.; Pokotilovskij, Yu.N.; Shelkova, I.G. (Mordovskij Gosudarstvennyj Univ., Saransk (USSR)). (Joint Inst. for Nuclear Research, Dubna (USSR). Lab. of Neutron Physics). 1987. 6p. (In Russian). NTIS (US Sales Only), PC A02/MF A01. Order Number DE88703743/JAW.

Submitted to the journal Nucl. Instrum. Methods.

Multilayer thin-film ferromagnetic shutters for ultracold neutrons are investigated. The shutters are manufactured by the method of thermal evaporation from special isotopic mixtures of ferromagnetic metals. The reached depth of modulation of the neutron flux $\sim$ 14, the transmission through the opened shutter is 0.36. The shutter is used for the time-of-flight correlation measurement of the spectrum of neutrons transmitted through the neutron reference filter. 7 refs.; 2 figs.

44294 **(JINR-R—10-87-535) Some features of modelling the energy spectra of elastically scattered ions.** Il'khamov, R.A.; Makhajdik, D. (Tashkentskij Gosudarstvennyj Univ. (USSR); Joint Inst. for Nuclear Research, Dubna (USSR). Lab. of Neutron Physics). (Joint Inst. for Nuclear Research, Dubna (USSR). Lab. of Neutron Physics). 1987. 9p. (In Russian). NTIS (US Sales Only), PC A02/MF A01. Order Number DE88703766/JAW.

The influence of such factors as losses of ions in the sample, the width of sample layers, geometrical conditions of experiments, the straggling and the energy resolution of measuring system on the form of plastic scattering spectra is investigated. Some characteristic features are demonstrated using the spectra of special testing samples. The calculations are performed using the RBSM code. 2 refs.; 7 figs.; 1 tab.

44295 **(KIYI—86-43) Calculation of angular and energy distributions of electrons, passed through the matter layers by Monte Carlo method. (Track programme).** Zdesenko, Yu.G.; Tretyak, V.I. (AN Ukrainskoj SSR, Kiev. Inst. Yadernykh Issledovanij). 1986. 27p. (In Russian). NTIS (US Sales Only), PC A03/MF A01. Order Number DE88703791/JAW.

A programme is worked out allowing to model the processes of electron interaction with matter and may be used at planning and making investigations of double-beta decay of atomic nuclei to optimize the experimental techniques and to analyse the measurement results. In calculation the energy losses of electrons inelastic collisions are taken into consideration with atomic electrons of medium causing the excitation and atom ionization (ionization losses) and also the bremsstrahlung appearing at electron acceleration in electric fields of atomic nuclei and shells (radiation losses). 20 refs.; 5 figs.; 5 tabs.

44296 **Time-dependent aspects of electron degradation. II. General theory.** Inokuti, M.; Kimura, M.; Dillon, M.A. (Argonne National Laboratory, Argonne, Illinois 60439). *Physical Review [Section] A: General Physics;* **38**: No. 3, 1217-1224(1 Aug 1988).

The well-known Spencer-Fano theory of electron-degradation spectra treats time-independent cases, in which the medium is subjected to stationary irradiation. We present a generalization to time-dependent cases, showing how to calculate the temporal behavior of the electron-degradation spectrum and of related quantities such as the yield of ions or excited states that are produced under nonstationary irradiation. The generalized theory indicates new aspects of electron-degradation phenomena, which are basic to radiation physics and chemistry as well as to applications such as gaseous electronics, upper-atmospheric physics, and astrophysics.

44297 **Linear half space transport equations with accretive, invertible collision operators.** Ganchev, A.H.; Greenberg, W. (Department of Mathematics and Center for Transport Theory and Mathematical Physics, Virginia Polytechnic Institute and State University, Blacksburg, Virginia 24061). *Transport Theory and Statistical Physics;* **17**: No. 1, 93-105(Feb 1988).

The one dimensional, linear, half space, abstract transport equation with an accretive, invertible collision operator is shown to be uniquely solvable. An example from multigroup neutron transport is given.

44298 **X-ray attenuation cross sections for energies 100 eV to 100 keV and elements Z = 1 to Z = 92.** Saloman, E.B.; Hubbell, J.H.; Scofield, J.H. (Center for Radiation Research, National Bureau of Standards, Gaithersburg, Maryland 20899). *Atomic Data and Nuclear Data Tables;* **38**: No. 1, 1-197(Jan 1988).

This work presents for the energy range 0.1—100 keV the National Bureau of Standards (NBS) database of experimental x-ray attenuation coefficients (total absorption cross sections) and cross sections calculated using a relativistic Hartree—Slater model for the photoelectric cross section for all elements of atomic number Z = 1—92. The information is displayed in both tabular and graphical form. Also shown on the graphs are cross sections obtained using the semiempirical set of recommended values of B. L. Henke and co-workers (Atomic Data and Nuclear Data Tables 27, 1 (1982)). A bibliography of the NBS database for this energy range is included. copyright 1988 Academic Press, Inc.

6550 Medical Physics

REFER ALSO TO CITATION(S) 43205, 43206, 43207, 43208, 43209, 43945, 43953, 43969

44299 **(DOE-RW—88.021) Effect of near-field properties on dose to man for a hypothetical repository for intermediate level wastes located at depth in an argillaceous formation.** Gralewski, Z.A.; Taylor, J.W.; Thorne, M.C. (Department of the Environment, London (UK); Electrowatt Engineering Services Ltd., Horsham (UK)). Dec 1987. 78p. (EWE—2618.031). NTIS (US Sales Only), PC A05/MF A01. Order Number DE88753843/JAW.

The degree to which near-field parameters may affect the release of radionuclides from a deep geological repository for intermediate level wastes located in an argillaceous formation is investigated using a sensitivity analysis approach. It is demonstrated that the duration of the physical integrity of waste canisters and vault structure is of little interest, with respect to the groundwater transport pathway. Chemical factors are of more significance and it is not always possible to separate their influence from the effects of geosphere factors.

44300 **(ENEA-RT-SAG—86-2) Automated station for the measurement of the total beta radioactivity in the air.** Bonini, E.; Cucchi, G. (ENEA, Rome (Italy)). 1986. 9p. (In Italian). NTIS (US Sales Only), PC A02/MF A01. Order Number DE88701725/JAW.

An automatic station for measuring the beta total radioactivity of air has been designed. The station consists in an intake section with a capacity of 384 cubic metres of air a day and a glass fibre ribbon filter and in a detection section with three shielded Geiger counters, a plastic beta detector and a NaI (Tl) crystal detector. This stage is linked to the counting section that processes the data and outputs the values of the radioactivity minimum, mean and maximum. The minimum radioactivity measurable is almost 0.015 pC; for such a radioactivity the relative error is 45%. For the mean values the relative error amounts to almost 10%. This station is therefore particularly reliable for its high sensitivity and for the little relative error.

44301 **(INIS-mf—11272) Study of mortality of Ontario miners, 1955-1977. Pt. 1.** Muller, J.; Kusiak, R.A.; Wheeler, W.C.; Suranyi, G.; Gentleman, J.F. (Ontario Ministry of Labour, Toronto (Canada); Ontario Workers' Compensation Board, Toronto (Canada); 5969435CA). (Ontario Ministry of Labour, Toronto (Canada); Ontario Workers' Compensation Board, Toronto (Canada); Atomic Energy Control Board, Ottawa, Ontario (Canada)). May 1983. 89p. NTIS (US Sales Only), PC A05/MF A01. Order Number DE88703584/JAW.

A mortality study of Ontario Mines covering the period of 1955 to 1977 was carried out. There are 50,201 men in the study for a total of 754,391 person-years and 6,757 deaths were observed in this population over the period of the study. The most serious hazard in this population was death due to violent causes. The population was subdivided into gold miners, nickel-copper miners, iron ore miners, other ore miners, mixed ore miners, and uranium miners. Only in certain types of miners was an increase in deaths from non-neoplastic lung disease detectable. A significant increase was noted in underground gold miners, mixed ore miners and in uranium miners. This increase was largely due to increased death rates from silicosis and chronic interstitial pneumonia. In addition there were 43 deaths due to silicotuberculosis in gold miners and 36 deaths due to the same cause in mixed ore miners. It is estimated that the total difference between observed and expected deaths from silicosis and chronic interstitial pneumonia as well as from silicotuberculosis which was observed gold miners and in mixed ore miners can actually be attributed to gold mining only. Increased cancer risk in non-uranium miners is observed for cancer of the trachea, bronchus and lung in full-time underground gold miners and full-time underground mixed ore miners, and cancer of the stomach in full-time underground gold miners. It is assumed that the increased risk of lung cancer in both these groups of miners is in fact due to underground gold mining only. As to uranium miners, previous studies have already demonstrated an increased lung cancer risk in these men and this finding was confirmed in this study. Men who have also worked for Eldorado Nuclear Limited show a siginificantly increased risk of death from all causes and from all disease causes.

44302 **(TsNIIATOMINFORM-ON—1-86) Assessment of population doses from X-ray examination in USSR (1970-1980).** Nikitin, V.V.; Ermakov, I.A.; Zherbin, E.A.; Ivanov, E.V.; Komarov, E.I.; Masarskij, L.I.; Ramzaev, P.V.; Saltykova, L.M.; Chervyakov, A.M. (Gosudarstvennyj Komitet po Ispol'zovaniyu Atomnoj Ehnergii SSSR, Moscow; Ministerstvo Zdravookhraneniya SSSR, Moscow. Natsional'naya Komissiya po Radiatsionnoj Zashchite). 1986. 26p. (In Russian). NTIS (US Sales Only), PC A03/MF A01. Order Number DE88703805/JAW.

Population dose from X-ray diagnostic examinations has been estimated in the USSR for 1970-1980 years. The estimation based on the analyses of frequency, structure, age and sex-distributions of X-ray procedures as well as on computed values of mean organ doses from these procedures. Collective effective dose equivalent to adult from diagnostic radiology in the USSR was 1.36, 1.38 and 1.35 mSv/man-year in 1970, 1975 and 1980 correspondingly. This stability (in spite of growing frequency of procedures) may be explained by the intensive decrease in the number of fluoroscopic examinations (from 42.1% in 1970 to 13.5 in 1980). During 10 years the mean population doses to red bone marrow, lungs, mammary glands and bone surfaces were decreased (by 15-30%), those to skin didn't changed and to thyroid, gonads and the "remainder" were increased (by 30-60%). The most irradiated organ was lung (4.07 and 3.05 mSv/man-year, in 1970 and 1980 respectively) the least irradiated - male gonads (0.09 and 0.14 mSv/man-year. 21 refs.; 8 tabs.

44303 **(TsNIIATOMINFORM-ON—6-86) Radiation doses to the Far North inhabitants.** Troitskaya, M.N.; Ermolaeva, A.P.; Nizhnikov, A.I.; Teplykh, L.A. (Gosudarstvennyj Komitet po Ispol'zovaniyu Atomnoj Ehnergii SSSR, Moscow; Ministerstvo Zdravookhraneniya SSSR, Moscow. Natsional'naya Komissiya po Radiatsionnoj Zashchite). 1986. 15p. (In Russian). NTIS (US Sales Only), PC A03/MF A01. Order Number DE88703810/JAW.

Radionuclides migration in the food chain "lichen-reindeerman" specific for the Far North areas has given rise to an excess internal irradiation of their inhabitants. The total effective dose equivalent to population group is about 7.5 mSvxyr/sup -1/. The main sources of the exposire of polar regions inhabitants are radon and thoron daughters in the inspired air (up to 3.0 mSvxyr/sup -1/), naturally occuring radionuclides, lead-210 and polonium-210, entering the body through ingestion (~ 1.0 mSvxr/sup -1/) and caesium-137 from global fallout, which at different time periods, produced the weighted average effective dose equivalents of the internal irradiation of the inhabitants from 2.4 to 0.6 mSvxyr/sup -1/. Body burdens resulted from natural radiation due to cosmic rays, potassium-40 and thorium-228 make the values accepted as the averages for the whole population of the world and are equal to 0.3, 0.3 and 0.002 mSvxyr/sup -1/ respectively. The effective dose equivalents from medical examinations of this populations group ranged from 0.40 to 0.60 mSvxyr/sup -1/. 8 refs.; 6 tabs.

44304 **(TsNIIATOMINFORM-ON—7-86) Radiation-hygienic aspects of personnel dosimetry as applied to medical radiologists. Occupational exposure of radiographic workstaff.** Balode, G.Yu.; Grinberg, S.M.; Gubatova, D.Ya.; Nemiro, E.A. (Gosudarstvennyj Komitet po Ispol'zovaniyu Atomnoj Ehnergii SSSR, Moscow; Ministerstvo Zdravookhraneniya SSSR, Moscow. Natsional'naya Komissiya po Radiatsionnoj Zashchite). 1986. 39p. (In Russian). NTIS (US Sales Only), PC A03/MF A01. Order Number DE88703811/JAW.

Experience in central personnel monitoring (PM) in Latviya is presented. The TELDE dosimetric set satisfying PM requirements is developed. Data on occupational doses to personnel of X-ray rooms (for more than 10 years) are presented. Comparison of distributions of individual annual doses depending on the type of clinical-preventive establishments (CPE), sex, age, working experience of personnel is conducted. It is shown, that the analyzed occupational groups work under radiation conditions with a relatively low level of risk. The technique for establishment of safety standards based on knowledge of distribution parameters of individual annual doses and certain values for different types of CPE and occupational groups are suggested. It is shown, that linear extrapolation with account of rate of accumulation characteristic for the given occupational group at an error not more than 20% for radiographic assistants may be used for forecasting doses obtained during lifespan. 17 refs.; 8 figs.; 9 tabs.

44305 **The application of saturable magnetics in the EMP protection of high power, RF transmitters.** Tasca, D.M.; Swant, D.H. (General Electric Co., Astro Space Div., King of Prussia, PA (US)). *IEEE (Institute of Electrical and Electronics Engineers) Transactions on Nuclear Science;* **NS-34**: No. 6, 1494-1501(Dec 1987). (CONF-8707112—).

From Annual conference on nuclear and space radiation effects; Snowmass Village, CO, USA (28 Jul 1987).

A unique and innovative all solid state, self recovery HESA design concept was developed for Kilowatt RMS level, RF transmitters using existing metal oxide varistor and saturable magnetic device technologies. This design concept, which is based on a two element hybrid protective device approach, has the dual capability to provide high voltage/fast rise time and long pulse/high current threat protection. The first element provides delay-free protection against the fast rise time HEMP threat and was implemented using metal oxide varistor technology which General Electric developed. The second element provides the high energy relief for the first element, and was implemented using saturable magnetics. Detailed magnetic device and varistor models and analytical design equa-

tions were derived and extensive material characteristics were experimentally obtained in support of this development. Much of this work involved the generation of singular information which was required to support the solutions to the design problems encountered in meeting the design challenge using existing materials technology. This paper addresses the saturable magnetics portion of this work.

6560 Condensed Matter Physics

44306 **(CEA-CONF—9178) Influence of H on the recrystallization of amorphous Si layers.** Oberlin, J.C.; Chami, A.C.; Ligeon, E.; Prunier, C. (CEA Centre d'Etudes Nucleaires de Grenoble, 38 (France). Dept. de Recherche Fondamentale). 1986. 12p. (CONF-8606101—). NTIS (US Sales Only), PC A03/MF A01. Order Number DE88754042/JAW.

From 5. international conference on ion beam modification of materials; Catania, Italy (9 Jun 1986).

This study concerns the epitaxial regrowth by furnace annealing of self amorphized and hydrogen implanted silicon. In the temperature range 500/sup 0/C - 575/sup 0/C, the regrowth rate at first decreases as the relative hydrogen concentration in the layer C/sub H/ increases. For C/sub H/ > 3 x 10/sup -3/ the regrowth rate is constant and independant of the hydrogen concentration. Its value is about half of that observed for undoped silicon. The activation energy (2.65 +- 0.1) eV does not vary significantly as a function of the relative hydrogen concentration in the range 0 < C/sub H/ < 3 x 10/sup -3/ for all temperatures. A regrowth model taking into account the presence of interstitial impurities in the layer is proposed. The modification on the regrowth rate in the neighbourhood of C/sub H/ = 3 x 10/sup -3/ is explained.

44307 **(CONF-880372—1) Brillouin scattering at high pressures.** Grimsditch, M.; Polian, A. (Argonne National Lab., IL (USA); Paris-6 Univ., 75 (France). Lab. de Physique des Milieux tres Condenses). Feb 1988. Contract W-31-109-ENG-38. 20p. NTIS, PC A 03; 3; GPO Dep. Order Number DE88011972/JAW.

From NATO advanced study institute on simple molecular systems at very high densities; Les Houches, France (29 Mar 1988).

Technical advances which have made Brillouin scattering a useful tool in high pressure diamond anvil cell (DAC) studies, viz. multipassing and tandem operation of Fabry-Perot interferometers, are reviewed. Experimental aspects, such as allowed scattering geometries, are outlined and the data analysis required to transform Brillouin spectra into sound velocities and elastic constants is presented. Experimental results on H_2, N_2, Ar, and He are presented, and the close relationship between the Brillouin scattering results and equations of state is highlighted.

44308 **(CONF-880522—1) Self-consistent charge and spin distributions in oxide superconductors.** Ellis, D.E.; Lam, D.J.; Veal, B.W. (Northwestern Univ., Evanston, IL (USA); Centro Brasileiro de Pesquisas Fisicas, Rio de Janeiro; Argonne National Lab., IL (USA)). Mar 1988. Contract W-31-109-ENG-38. 27p. NTIS, PC A 03; 3; GPO Dep. Order Number DE88012051/JAW.

From Latin-American conference on high-temperature superconductivity; Rio de Janeiro, Brazil (5 May 1988).

The self-consistent field local density theory provides a useful first principles theoretical basis for the description of electronic charge and spin distributions in complex materials. The ground state energy levels and charge and spin densities of copper-oxide based superconductors are discussed in terms of both band structure and molecular cluster models. X-ray photoemission and absorption data are considered, along with charge transport properties, to provide essential data necessary to understand basic bonding and excitation mechanisms. An embedded cluster approach is used to represent cluster-host interactions with long-range terms included by Ewald summation. X-ray absorption near-edge spectra (XANES) are calculated for the Cu K-edge and compared with experiment in an effort to identify different valence states assumed to be involved in superconductive electron-pairing in certain models. The effects of probable defects and impurities on the electronic structure, especially those due to transition metals on substitutional sites, are calculated in the cluster scheme. Electric field gradients and isomer shifts are determined at Fe- substituted Cu sites for comparison with Mossbauer data and with the unperturbed host Cu sites.

44309 **(CONF-8803115—1) Quasiperiodic ordering in grain boundaries.** Rivier, N.; Lawrence, A.J.A. (Argonne National Lab., IL (USA); Heriot-Watt Univ., Edinburgh (UK). Dept. of Mathematics). Apr 1988. Contract W-31-109-ENG-38. 10p. NTIS, PC A 02; 3; GPO Dep. Order Number DE88012199/JAW.

From ILL/CODEST workshop on quasicrystalline materials; Grenoble, France (21 Mar 1988).

The authors show that a general grain boundary consists of a quasiperiodic grid of topological dislocation lines, with the same golden or noble inflation coefficient in all directions. In some particular cases, the grid may be periodic in one or more directions along with translational symmetry then replaces inflation symmetry.

44310 **(FEI—1866) Study of radiation-induced defects in platinum by Moessbauer spectroscopy.** Bogdanov, V.V.; Zakurkin, V.V.; Pen'kov, Yu.P. (Gosudarstvennyj Komitet po Ispol'zovaniyu Atomnoj Ehnergii SSSR, Obninsk. Fiziko-Ehnergeticheskij Inst.). 1987. 9p. (In Russian). NTIS (US Sales Only), PC A02/MF A01. Order Number DE88703498/JAW.

Investigation of annealing of radiation induced defects in platinum (with /sup 57/Co isotope addition) after 1.5 MeV proton irradiation up to the 1x10 /sup 18/ cm/sup -2/ dose at 85 K is carried out by the Moessbauer spectroscopy method. Analysis of the dependence of spectra parameters on annealing in the temperature range from 300-700 K permitted to determine two components corresponding to complexes of different intrinsic interstitial - /sup 57/Co atom structure. The evolution character of the complex with the annealing temperature agrees with the supposition concerning the activation of vacancy migration in platinum at T>400 K. 13 refs.; 1 fig.

44311 **(IAE—4422/7) Photon spectrum anomalies and Fermi surface in electronic copper base alloys.** Ivanov, A.S.; Mitrofanov, N.L.; Rumyantsev, A.Yu.; Chernoplekov, N.A.; Vajs, L.; Ehshrig, Kh. (Gosudarstvennyj Komitet po Ispol'zovaniyu Atomnoj Ehnergii SSSR, Moscow. Inst. Atomnoj Ehnergii). 1987. 17p. (In Russian). NTIS (US Sales Only), PC A03/MF A01. Order Number DE88703500/JAW.

Anomalies of Kohn- and Taylor-types are registered on the curves of phonon dispersion in the Cu+12.5%Ga alloy using the method of neutron inelastic scattering. Separate sections of the Fermi surface (FS) of the alloy are plotted by positions of explicit Kohn anomalies in the vicinity of the X point of Brillouin zone. Change of FS sizes is stated to be in correspondence with variation of conductivity electron concentration at formation of a disordered solid solution of gallium atoms in copper lattice. Conditions for arising anomalies of Kohn and Taylor types in copper and in Cu-Ga alloy are analyzed on the basis of the conducted calculations of copper electron band structure, and the effect of spectrum electron composition on the character of arising anomalies is considered. It is noted that approximation of "rigid zones" used in analysis of the electron band structure of Cu-Ga alloy satisfactorily describes change of the FS section of the alloy in the direction (110) of the reverse lattice with increase in conductivity electron density. 22 refs.; 7 figs.; 1 tab.

44312 **(IAE—4429/9) Refractive shift of neutron Bragg reflection.** Podurets, K.M.; Shil'shtejn, S.Sh.; Aichhorn, F. (Gosudarstvennyj Komitet po Ispol'zovaniyu Atomnoj Ehnergii SSSR, Moscow. Inst. Atomnoj Ehnergii). 1987. 8p. (In Russian). NTIS (US Sales Only), PC A02/MF A01. Order Number DE88703501/JAW.

Experiments on observation of refractive shift in asymmetric neutron Bragg refraction by germanium crystals depending on change in the refractive index with unchangeable geometry are carried out. Two values of the refractive index jump on the same crystal surface were established by simultaneous neutron refraction with multiple wave lengths, by partial crystal submergence (into heavy

water) and by establishing a jump of magnetic induction of the crystal surface. Shifts in the Bragg refractions reaching 40-50 angular seconds are observed. The demonstrated methods of observed refraction shift can be used to measure the refractive indices. 9 refs.; 6 figs.

44313 **(INIS-mf—11122) Isolated molecules in metals. A study of the geometrical and chemical bonding structure of isolated molecules of a substitutional 5sp-element atom and interstitial electronegative atoms embedded in noble metals using Moessbauer spectroscopy and ion beam analysis.** Andreasen, H.I. (Rijksuniversiteit Groningen (Netherlands)). 28 Sep 1987. 121p. NTIS (US Sales Only), PC A06/MF A01. Order Number DE88701757/JAW.

Contains summary in Dutch.

The structure of isolated molecules in the noble metals copper, silver and gold, consisting of a single 5sp-element atom bound to a number of interstitial oxygen or fluorine atoms, has been studied by means of Moessbauer spectroscopy combined with ion beam analysis. The impurities were introduced in the metal crystals by implantation with an isotope separator or, in the case of oxygen in silver and gold, by annealing the sample in an oxygen atmosphere. The formation of molecules was monitored from the new components appearing in the Moessbauer spectra recorded in emission mode from the radioactive source atoms ^{119}Sb, /sup 119m/Te, /sup 121m/Sn, ^{121}Te and /sup 129m/Te, which decay through the Moessbauer states in ^{119}Sn, ^{121}Sb and ^{129}I. Depth profiling and site-location was carried out by means of nuclear reaction analysis utilizing the resonant reactions $^{16}O(p,\alpha)^{15}N$ and $^{19}F(\alpha,p)^{22}Ne$, and by means of Rutherford backscattering and channeling. Information about the chemical strucure was derived from the analysis of the Moessbauer spectra. 96 refs.; 35 figs.; 2 tabs.

44314 **(INIS-SU—39/A) Numerical simulation of the problem on electromagnetic and acoustic wave transformation in metals in magnetic field.** Kaner, Eh.A.; Sal'nikova, L.P.; Fal'ko, V.L. (AN Ukrainskoj SSR, Kharkov. Inst. Radiofiziki i Ehlektroniki). 1986. 24p. (In Russian). NTIS (US Sales Only), PC A03/MF A01. Order Number DE88703587/JAW.

Preprint 302.

Mathematical modeling of the problem on transformation of an electromagnetic wave into an acoustic one in alkaline metals in the magnetic field perpendicular to the sample surface has been carried out. Two model of specular and diffuse reflection of electrons are considered. The ultrasonic amplitude on the sample surface and the amplitude of the passed signal are determined with the various parameters; magnitudes of the external magntic field, probable constant of the electron-phonon interaction and ultrasonic wavelength to electron free-path length ratio are calculated. The results of numerical modeling are shown by plots clearly demonstrating in what regions of the parameter changing of the problem the induction of deformation mechanism of the ultrasonic generation becomes dominant. Short description of the programm is given here as well.

44315 **(JINR-R—14-87-744) Determination and analysis of polycrystal structure factors on DN-2 neutron diffractometer.** Balagurov, A.M.; Beskrovnyj, A.I.; Popa, N.; Sangaa, D. (Joint Inst. for Nuclear Research, Dubna (USSR). Lab. of Neutron Physics). 1987. 11p. (In Russian). NTIS (US Sales Only), PC A03/MF A01. Order Number DE88703783/JAW.

The procedure of handling the diffraction spectra of polycrystal substances measured with a neutron diffractometer by a time-of-flight method is presented. The given procedure contains the transformation of two-dimension spectra into one-dimension ones and the application of the Retveld method to the structure parameter determination. To describe the diffraction peak the DN-2 resolution function constructed in a wide range of interplane distances and scattering angles is used. The examples of handling the Al/sub 2/O/sub 3/ and KD/sub 2/PO/sub 4/ model crystals are given. 17 refs.; 3 figs.; 1 tab.

44316 **(KFTI—87-48) Experimental study on the ionizing radiation field in absorbers irradiated by the 0.8 GeV and 1.2 GeV electrons.** Ambrosimov, V.K.; Kalmykov, N.N.; Kovalenko, G.D. and others. (AN Ukrainskoj SSR, Kharkov. Fiziko-Tekhnicheskij Inst.). 1987. 14p. (In Russian). NTIS (US Sales Only), PC A03/MF A01. Order Number DE88703790/JAW.

The measurement results of spatial distribution of aluminium detector energy release and radioactivity in absorbers irradiated by 0.8 and 1.2 GeV electrons are given. Absorbers are made of aluminium, iron and lead, 30x30 cm size across the thickness is about 18 radiation length units. Thermoluminescence dosimeters LiF and radiochromium film dosimeters have been used to measure energy release. Induced activity of /sup 18/F and /sup 24/Na nuclides is determined in aluminium detectors. The experimental data are compared with the results of calculation carried out by the Monte-Carlo method. 20 refs.; 10 figs.; 5 tabs.

44317 **(SAND—87-2806C) Laser interferometric dilatometer for low-expansion materials.** Drotning, W.D. (Sandia National Labs., Albuquerque, NM (USA)). 1988. Contract AC04-76DP00789. 21p. (CONF-880606—4). NTIS, PC A03/MF A01; 1; GPO Dep. Order Number DE88012329/JAW.

From 10. symposium on thermophysical properties; Gaithersburg, MD, USA (20 Jun 1988).

The development of a high-precision dilatometer based on interferometry presents a number of challenges. This paper describes a laser interferometric dilatometer developed for high-precision thermal expansion measurements in the materials laboratory. The Sandia dilatometer uses dual-beam laser interferometry with a computer-controlled optical alignment feature to achieve high-precision length change measurements. This device has been modified to expand its measurement capabilities in a number of areas. A new thermal chamber has been incorporated which provides a range of measurement from 90 to 500 K while minimizing thermal effects on the optical portion of the instrument. A new specimen holder has been developed to cover this temperature range while accommodating a wider variety of specimen types. In particular, thin (1 mm) composites may be employed in the holder, which uses a single specimen, with only modest shape and preparation requirements, to provide absolute length change measurements. Tilt errors limit the overall performance of dilatometers based on dual-beam interferometry. Significant improvements in precision were demonstrated by incorporating a unique optical system which independently measures specimen holder tilt; tilt errors were corrected and a length change resolution near 0.4 microstrain was achieved. Expansion coefficient data obtained with the device agreed with established results on fused silica, platinum, and stainless steel. New expansion data were obtained from 90 to 293 K on stainless steel, NBS Standard Reference Material 738.

44318 **Density of states transformation Monte Carlo method: Thermodynamics of the Lennard-Jones fluid.** Shaw, M.S. (Los Alamos National Laboratory, Los Alamos, New Mexico 87545). *Journal of Chemical Physics;* **89**: No. 4, 2312-2323(15 Aug 1988).

The standard NVT ensemble Metropolis Monte Carlo method is modified to include uniformly weighted steps in ln β as well as weighted steps in U, the total potential energy. This simulation is used to sample a soft sphere (r/sup -12/ potential) fluid over a very wide range of energies. For each r/sup -12/ energy U/sub 12/ , the corresponding r^{-6} energy U_6 is also recorded. Information from the simulation is used to determine relative values of the configurational density of states γ/sub 12/(U/sub 12/) (i.e., the number of configurations with total potential energy between U/sub 12/ and $U_{12}+dU_{12}$) for the soft sphere fluid over a large range in energy. Then using the distribution of U_6 at each U/sub 12/, the configurational density of states for arbitrary linear combinations of U/sub 12/ and U_6 is determined and the equation of state for the Lennard-Jones fluid is evaluated for a wide range of densities and temperatures in a very efficient manner. The generalization to simulations of other linear combinations of potentials is discussed.

44319 **Mean field approach to molecule—surface scattering at finite temperature: One phonon theory.** Jackson, B. (Department of Chemistry, University of Massachusetts, Amherst, Massachusetts 01003). *Journal of Chemical Physics;* **89**: No. 4, 2473-2481(15 Aug 1988).

A theory is presented for the phonon inelastic scattering of light atoms and molecules from surfaces. Both the gas species and the thermal fluctuations of the solid are treated in a fully quantum fashion. A self-consistent field method is used to reduce the evolution of the reduced density matrix to the propagation of a single wave function and a set of coefficients describing phonon excitation and annihilation. The method allows one to extend recent time dependent molecule—surface scattering theories to finite temperature, with only a small increase in computer time. Agreement is found with experimental data for the thermal attenuation of diffraction peaks for He scattered from Cu. Energy transfer is found to be sensitive to the steepness of the repulsive potential, the molecular kinetic energy, and the angle of incidence, and only weakly dependent on the well depth. The "Beeby correction" is examined and shown to be invalid, except at very low beam energies where there is a small correlation between well depth and inelastic scattering. For this model, energy transfer does not scale with the normal component of the beam energy.

44320 **Nature of misfit dislocation sources in strained-layer semiconductor structures.** Dodson, B.W. (Sandia National Laboratories, Albuquerque, New Mexico 87185-5800). *Applied Physics Letters;* **53**: No. 5, 394-396(1 Aug 1988).

It is currently possible to grow nearly perfect strained-layer semiconductor heterostructures. Experimental evidence shows that misfit dislocation sources become active almost immediately as the layer thickness exceeds the equilibrium critical thickness. These dislocation sources do not seem related to obvious causes, such as threading dislocations or homogeneous nucleation at surface structures. It is argued here that the dislocation sources are inhomogeneous in nature and result from local stress concentrations near the surface.

44321 **Stress and elastic constants in anisotropic solids: Molecular dynamics techniques.** Lutsko, J.F. (Materials Science Division, Argonne National Laboratory, Argonne, Illinois 60439). *Journal of Applied Physics;* **64**: No. 3, 1152-1154(1 Aug 1988).

The local stress tensor commonly used in statistical mechanics is cast in a form useful for molecular dynamics (MD) simulations. It is then used to derive fluctuation formulas for the local elastic constants of a system. The formulas are used in an MD measurement of the local elastic constants of an ideal crystal which are found to be in good agreement with the bulk elastic constants of the same system.

44322 **Maximally discretized molecular dynamics.** Colvin, M.E.; Ladd, A.J.C.; Alder, B.J. (Lawrence Livermore National Laboratory, Livermore, California 94550). *Physical Review Letters;* **61**: No. 4, 381-384(25 Jul 1988).

It is shown that the coarsest discretization of positions and velocities in molecular dynamics leads to qualitatively correct transport coefficients and quantitatively predictable long-time tails in the velocity autocorrelation function, but requires orders of magnitude less computer time than standard molecular-dynamics methods.

44323 **Mobile vacancies in a quantum Heisenberg antiferromagnet.** Shraiman, B.I.; Siggia, E.D. (AT&T Bell Laboratories, Murray Hill, New Jersey 07974). *Physical Review Letters;* **61**: No. 4, 467-470(25 Jul 1988).

The ground state of a quantum vacancy in a 2D antiferromagnet is found to involve a long-range dipolar distortion of the staggered magnetization. An effective Hamiltonian for vacancies interacting with long-wavelength spin waves is derived. The implications for the antiferromagnetic long-range order are discussed.

44324 **Time-dependent screening in the electron gas.** Canright, G.S. (Solid State Division, Oak Ridge National Laboratory, Oak Ridge, Tennessee 37831). *Physical Review [Section] B: Condensed Matter;* **38**: No. 3, 1647-1653(15 Jul 1988).

The transient screening response in real space and time of the electron gas to a suddenly created point charge is calculated in the linear approximation, in a way which allows the decomposition of the response into a part due to plasmons and a part due to electron-hole pairs. The results are expected to be qualitatively correct as a description of core-hole creation in simple metals in the limit of large photoelectron energies. We obtain a clear picture of an electronic "shock wave" which propagates outward from the core hole with some dispersion; the group velocities are centered at the Fermi velocity. Behind the shock wave is the static distribution plus a small ringing due to small-q plasmons. The results are examined in the light of experimental evidence for transient effects on core-hole decay.

44325 **Exact solution of a periodic-cluster Hubbard model with an electron-lattice interaction.** Proetto, C.R.; Falicov, L.M. (NORDITA, Blegdamsvej 17, DK-2100 Copenhagen OX, Denmark). *Physical Review [Section] B: Condensed Matter;* **38**: No. 3, 1754-1762(15 Jul 1988).

An exact solution of a modified Hubbard model for a tetrahedral cluster with periodic boundary conditions is presented. It includes a static electron-lattice interaction in which the intersite bond-hopping parameter is a function of the bond electron occupation. It is found that the intrasite Coulomb repulsion and the effective attractive electron-lattice interaction have, generally speaking, opposite (although not identical) effects. They cancel each other exactly along a line of singularities in parameter space. The state vectors are easily obtained analytically. A study is made of magnetic and superconducting static correlation functions as functions of the parameters. Various forms of anisotropic superconducting fluctuations are favored in the various regimes. There is an indication of possible states with coexisting nonuniform, nonisotropic superconductivity and antiferromagnetism caused by a "compromise" between the competing forces.

44326 **Nonlocal theory of thermal conductivity.** Mahan, G.D.; Claro, F. (Department of Physics, University of Tennessee, Knoxville, Tennessee 37996). *Physical Review [Section] B: Condensed Matter;* **38**: No. 3, 1963-1969(15 Jul 1988).

We have derived a nonlocal theory of thermal conductivity for the case in which the heat is carried by phonons. There is a nonlocal relation between the heat current J(r) and the temperature gradient delT(r'). The nonlocal theory is needed whenever the phonon mean free path is long compared to the distance scale of the variation in delT. The theory is used to explain some previous experiments in silicon.

44327 **Three-dimensional numerical simulations for activated hopping conduction.** Zimmerman, D.S.; Shegelski, M.R.A. (Solid State Division, Oak Ridge National Laboratory, Oak Ridge, Tennessee 37831-6030). *Physical Review [Section] B: Condensed Matter;* **38**: No. 3, 2068-2071(15 Jul 1988).

We model hopping conduction in a three-dimensional, lightly doped compensated semiconductor using a Miller-Abrahams—type resistor network. A flat density of states of width Δepsilon-c is used. We work with the full expression for the resistances instead of the T→0 asymptotic form usually employed. We report the first detailed numerical calculations of the overall resistance of a three-dimensional resistor network using this full expression. We find a temperature regime where the hopping conduction has a ratio of activation energy to bandwidth epsilon-c-tilde$_3$ = epsilon-c$_3$/Δepsilon-c = 0.217(8). This value agrees with the analytically determined value calculated by Shegelski and Barrie (SB), and disagrees with results reported by other workers, thereby validating SB's analytic theory and their claim that the full expression for the resistor network should be used in calculations of epsilon-c-tilde$_3$. An investigation is made into the dependence of epsilon-c-tilde$_3$ on Δepsilon-c; we find, in qualitative agreement with SB, that epsilon-c-tilde$_3$ decreases with Δepsilon-c and we present improved values for epsilon-c-tilde$_3$ as a function of Δepsilon-c.

44328 Functional integral theories of low-dimensional quantum Heisenberg models. Arovas, D.P.; Auerbach, A. (The James Franck Institute, The University of Chicago, 5640 South Ellis Avenue, Chicago, Illinois 60637). *Physical Review [Section] B: Condensed Matter;* **38**: No. 1, 316-332(1 Jul 1988).

We investigate the low-temperature properties of the quantum Heisenberg models, both ferromagnetic and antiferromagnetic, in one and two dimensions. We study two different large-N formulations, using Schwinger bosons and S = (1/2 fermions, and solve for their low-order thermodynamic properties. Comparison with exact solutions in one dimension demonstrates the applicability of this expansion to the physical models at N = 2. For the square lattice, we find at the mean-field level a low-temperature correlation length which behaves as ξproportionalexp(A/T), where A asymptotically approaches $2\pi S^2$ for large spin S, but A/sub S//sub //sub = //sub 1/2/≃1.16 and A/sub S//sub //sub = /1≃5.46. We mention the relevance of our results to recent experiments in La_2CuO_4.

44329 Acoustic plasmons in a two-dimensional, two-component electron liquid. Vignale, G. (Solid State Division, Oak Ridge National Laboratory, Oak Ridge, Tennessee 37831-6032). *Physical Review [Section] B: Condensed Matter;* **38**: No. 1, 811-814(1 Jul 1988).

We derive analytical formulas for the dispersion and damping of acoustic plasmons (i.e., plasmons with linear dispersion at small wave vectors) in a two-dimensional, two-component electron liquid. Our formulas include the effect of short-range correlations by means of local-field corrections, and reduce to the random-phase approximation when these corrections are neglected. Explicit calculations, using a Hubbard-like approximation for the local-field corrections, show that the acoustic plasmon exists only at comparatively small wave vectors. Strong short-range correlations may even suppress it.

44330 Incipient infinite degeneracy and the delocalization transition in a quasiperiodic potential. Luban, M.; Luscombe, J.H.; Kim, S. (Ames Laboratory and Department of Physics, Iowa State University, Ames, Iowa 50011). *Physical Review Letters;* **60**: No. 25, 2689-2692(20 Jun 1988).

We show that there exists an infinite near degeneracy of localized eigenstates for the almost-Mathieu equation when a dimensionless coupling constant Δ exceeds Δ/sub c/equivalent1, the Aubry-Andre critical value. This is an immediate consequence of the quasiperiodic character of the potential. Concomitant with the transition from localized to extended eigenstates, the near degeneracy gives way to an incipient infinite degeneracy, with the energy differences of pairs of states generally vanishing as (Δ-Δ/sub c/)/sup γ/ for Δ→Δ/sub c/+.

44331 Processing enhanced SEU tolerance in high density SRAMs. Fu, J.S.; Lee, K.H.; Koga, R.; Kolanski, W.A.; Weaver, H.T.; Browning, J.S. (Sandia National Labs., P.O. Box 5800, Albuquerque, NM (US)). *IEEE (Institute of Electrical and Electronics Engineers) Transactions on Nuclear Science;* **NS-34**: No. 6, 1322-1325(Dec 1987). (CONF-8707112—).

From Annual conference on nuclear and space radiation effects; Snowmass Village, CO, USA (28 Jul 1987).

The authors report theoretical calculations and experimental verification of an increase in memory cell SEU tolerance when Sandia's 2μm-technology 16K SRAMs are fabricated with a radiation-hardened 1μm CMOS process. An advanced 2D transient transport-plus-circuit simulator has been employed to calculate the differential contributions from each of the vertical dimensional changes in the transition from the 2-μm process to the 1-μm process. Error cross-section data, performed at the Berkeley cyclotron, on the first such device lot indicate that total improvement in threshold LET is a factor of 2 or better. A saturation phenomenon associated with the high-LET events is described and physical mechanisms responsible for the saturation are discussed.

6561 Superconductivity

REFER ALSO TO CITATION(S) 43507, 43509, 43511, 43513, 43515, 43517

44332 (IAE—4462/9) Superconductivity mechanism in metallic oxides with variable valence and role of softening effect for elasticity module. Ionov, S.P.; Manakova, L.A. (Gosudarstvennyj Komitet po Ispol'zovaniyu Atomnoj Ehnergii SSSR, Moscow. Inst. Atomnoj Ehnergii). 1987. 28p. (In Russian). NTIS (US Sales Only), PC A03/MF A01. Order Number DE88703506/JAW.

Additions to elasticity modules and interatomic distances depending on pair concentration and temperature are shown to occur in crystals with local electron pairs. The mechanism of change in lattice parameters is connected with the account of intercentered correlations and pair transfer to the lattice. The addition values is determined by the first- and second-order derivatives in unperturbed intercentered distance of the Coulomb pair interaction in neighbouring nodes and the corresponding overlapping integrals. The feature of lattice parameter dependences on concentration and temperature is the presence of extrema as well as jumpwise change from the disordered state to change - ordered one. 11 refs.; 5 figs.

44333 (JINR-R—8-86-859) Transition of the Kosterlitz-Thouless type in bulk system. Fisher, Eh.; Khukhareva, I.S. (Joint Inst. for Nuclear Research, Dubna (USSR). Lab. of High Energy). 1986. 20p. (In Russian). NTIS (US Sales Only), PC A03/MF A01. Order Number DE88703753/JAW.

Submitted to the journal Zh. Ehksp. Teor. Fiz. .

Experimental research results of composite superconductor resistive behaviour when current passing perpendicularly to the superconducting filements are presented. Samples of peculiarities depending on the temperature and measuring current, in particular, two-step transition to superconducting state. Analysis of the obtained regularities is made, on its base a model of topological transitions of the Kosterlitz-Thouless type in bulk-systems is developed. New type of topological defects is considered: excitations stimulated by current. The obtained empirical regularities are scale-invariant in relation to ξ=1/1c value. The interrelation between characteristic values in two- and three-dimensional systems is established. 22 refs.; 15 figs.

44334 (JINR-R—8-87-315) Modified soldered joints of current-carrying superconductors. Goncharov, I.N.; Miu, L. (Joint Inst. for Nuclear Research, Dubna (USSR). Lab. of High Energy; Institutul Central de Fizica, Bucharest (Romania)). (Joint Inst. for Nuclear Research, Dubna (USSR). Lab. of High Energy). 1987. 7p. (In Russian). NTIS (US Sales Only), PC A02/MF A01. Order Number DE88703754/JAW.

Submitted to the journal Cryogenics.

The improved soldered joints of the composite superconductors are proposed. Their resistivity was measured under different variants of preparing at T=4.2 K and B≦6 T. 4 refs.; 1 fig.; 1 tab.

44335 (JINR-R—14-87-644) Lattice dynamics and electron-phonon coupling in rhenium defect structures. Belushkin, A.V.; Natkanets, I.; Khabrylo, S.; Shitikov, Yu.L.; Zemlyanov, M.G.; Tulina, N.A. (Joint Inst. for Nuclear Research, Dubna (USSR). Lab. of Neutron Physics; Gosudarstvennyj Komitet po Ispol'zovaniyu Atomnoj Ehnergii SSSR, Moscow. Inst. Atomnoj Ehnergii; AN SSSR, Chernogolovka. Inst. Fiziki Tverdogo Tela). (Joint Inst. for Nuclear Research, Dubna (USSR). Lab. of Neutron Physics). 1987. 10p. (In Russian). NTIS (US Sales Only), PC A02/MF A01. Order Number DE88703782/JAW.

Submitted to the journal Sov. Phys. - Solid State.

The dynamics properties of the lattice of rhenium-molybdenum alloys (2 at% and 5 at%) and plastically deformed rhenium are investigated by the methods of neutron and point-contact spectroscopy. Based on the double differential cross sections of the inelastic neutron scattering the phonon spectra are reconstructed. From the results of measurements of the second derivative of the current - voltage characteristics made in samples under investigation, a point-

contact function of electron-phonon interaction is obtained. The electron-phonon coupling constants derived from point-contact spectra allowed one to estimate the changes in superconducting transition temperature (T) in rhenium due to molybdenum atoms and plastic deformation. These changes are in good agreement with experiment. The transformations of phonon spectra, obtained from neutron data, explain changes in T/sub c/ only for deformed rhenium. On the basis of these data the conclusion was made that main in the case of deformed rhenium the changes in T/sub c/ are due to phonon spectrum transformation and in the case of rhenium-molybdenum alloys the influence of phonons is comparable with the influence of electron subsystem. 12 refs.; 5 figs.; 3 tabs.

44336 **Perpendicular upper critical field and critical temperature of superconducting—interphase—normal-metal multilayers.** Ledvij, M.; Dobrosavljevic-Grujic, L.; Clem, J.R. (Institute of Physics, P.O. Box 57, 11001 Belgrade, Yugoslavia). *Physical Review [Section] B: Condensed Matter;* **38**: No. 1, 129-134(1 Jul 1988).

Proximity-effect theory of superconductor—normal-metal (S/N) superlattices is extended to the case of multilayers with an interphase between S and N layers. A nonmonotonic dependence of the superlattice critical temperature on the period A is obtained theoretically, in accordance with experiments of Qian et al. on Nb/Ti. Similar behavior of the perpendicular upper critical field H/sub c/$_2$ is predicted.

44337 **Superconducting ground state of noninteracting particles obeying fractional statistics.** Laughlin, R.B. (Department of Physics, Stanford University, Stanford, California 94305-4060). *Physical Review Letters;* **60**: No. 25, 2677-2680(20 Jun 1988).

In a previous paper, Kalmeyer and Laughlin argued that the elementary excitations of the original Anderson resonating valence bond model might obey fractional statistics. In this paper, it is shown that an ideal gas of such particles is a new kind of superconductor.

6570 Theoretical And Mathematical Physics

REFER ALSO TO CITATION(S) 44013, 44028, 44139, 44145, 44180, 44190, 44191, 44280

44338 **(IC—87/333) Colombeau's generalized functions and non-standard analysis.** Todorov, T.D. (International Centre for Theoretical Physics, Trieste (Italy)). Oct 1987. 14p. NTIS (US Sales Only), PC A03/MF A01. Order Number DE88703513/JAW.

Using some methods of the Non-Standard Analysis we modify one of Colombeau's classes of generalized functions. As a result we define a class ϵ-circumflex of the so-called meta-functions which possesses all good properties of Colombeau's generalized functions, i.e. (i) ϵ-circumflex is an associative and commutative algebra over the system of the so-called complex meta-numbers C-circumflex; (ii) Every meta-function has partial derivatives of any order (which are meta-functions again); (iii) Every meta-function is integrable on any compact set of R/sup n/ and the integral is a number from C-circumflex; (iv) ϵ-circumflex contains all tempered distributions S', i.e. S' is contained in ϵ' isomorphically with respect to all linear operations (including the differentiation). Thus, within the class ϵ-circumflex the problem of multiplication of the tempered distributions is satisfactorily solved (every two distributions in S' have a well-defined product in ϵ-circumflex). The crucial point is that C-circumflex is a field in contrast to the system of Colombeau's generalized numbers C-bar which is a ring only (C-bar is the counterpart of C-circumflex in Colombeau's theory). In this way we simplify and improve slightly the properties of the integral and notion of "values of the meta-functions" as well as the properties of the whole class ϵ-circumflex itself if compared with the original Colombeau theory. And, what is maybe more important, we clarify the connection between the Non-Standard Analysis and Colombeau's theory of new generalized functions in the framework of which the problem of multiplication of distributions was recently solved. (author). 14 refs.

44339 **(IC—87/345) Bessel polynomials and their differential operators.** Onyango Otieno, V.P. (International Centre for Theoretical Physics, Trieste (Italy)). Oct 1987. 14p. NTIS (US Sales Only), PC A03/MF A01. Order Number DE88703514/JAW.

Differential operators associated with the ordinary and the generalized Bessel polynomials are defined. In each case the commutator bracket is constructed and shows that the differential operators associated with the Bessel polynomials and their generalized form are not commutative. Some applications of these operators to linear differential equations are also discussed. (author). 4 refs.

44340 **(IC—87/346) Differential operators associated with Gegenbauer polynomials - 1: The limit-circle case.** Onyango Otieno, V.P. (International Centre for Theoretical Physics, Trieste (Italy)). Oct 1987. 24p. NTIS (US Sales Only), PC A03/MF A01. Order Number DE88703515/JAW.

We study the right-definite limit-circle case ($1/2 \leq \upsilon < 3/2$) of the Gegenbauer differential equation -((1-x/sup 2/)/sup υ+1/2/ y')'+υ/sup 2/(1-x/sup 2/)/sup υ-1/2/y(x) =λ(1-x/sup 2/)/sup υ-1/2/y(x), ($x \in (-1,1)$, $\lambda \in C$), following Titchmarsh's classical approach. We link the Titchmarsh method with operator theoretic results in the space L/sup 2//sub w/(-1,1). (author). 16 refs.

44341 **(IC—87/347) Differential operators associated with Gegenbauer polynomials - 2: The limit-point case.** Onyango Otieno, V.P. (International Centre for Theoretical Physics, Trieste (Italy)). Oct 1987. 19p. NTIS (US Sales Only), PC A03/MF A01. Order Number DE88703516/JAW.

In this paper we study the limit-point case of the Gegenbauer differential equation -((1-x/sup 2/)/sup υ+1/2/y'(x))/sup 1/ +υ/sup 2/(1-x/sup 2/)/sup υ-1/2/ y(x)=λ(1-x/sup 2/)/sup υ-1/2/ y(x), ($x \in (-1,1)$, $\lambda \in C$) in both the so-called right-definite and left-definite cases based partially on a classical approach due to E.C. Titchmarsh. We then link the Titchmarsh approach with operator theoretic results in the spaces L/sup 2//sub w/(-1,1) and H/sup 2// sub p,q/(-1,1). (author). 19 refs.

44342 **(IC—87/376) Surface waves.** Khalil, F. (International Centre for Theoretical Physics, Trieste (Italy)). Nov 1987. 19p. NTIS (US Sales Only), PC A03/MF A01. Order Number DE88703518/JAW.

Two dimensional surface waves including surface tension are considered in this paper. The disturbance potential phi created by a moving concentrated pressure has been determined uniquely following Peters. Linearized free surface conditions have been utilized. The free surface elevations eta(x) have been obtained and discussed for stream velocities $U \geq = < U$/sub min/, the minimum wave velocity. The results obtained are satisfactory. It is hoped that a similar approach may help to solve the three dimensional problem. It is, of course, apprehended that it may lead to complications which may not be easy to handle theoretically. (author). 11 refs, 5 figs.

44343 **(IC—88/37) Canonical group actions.** Carinena, J.F. (International Centre for Theoretical Physics, Trieste (Italy)). Mar 1988. 22p. NTIS (US Sales Only), PC A03/MF A01. Order Number DE88703528/JAW.

Canonical transformation theory for symplectic systems and an analysis of global aspects of the theory of symmetry groups of locally Hamiltonian dynamical systems are presented. 8 refs.

44344 **(IC—88/42) On the thermal stability of a radiating gas under general differential approximation.** Bestman, A.R. (International Centre for Theoretical Physics, Trieste (Italy)). Feb 1988. 13p. NTIS (US Sales Only), PC A03/MF A01. Order Number DE88703530/JAW.

The thermal stability of a radiating gas in a semi-infinite space is studied under a general differential approximation. The fluid is bounded on the axis $z'=0$ by a horizontal infinite wall maintained at a temperature T/sub 0/ which is high enough for radiative heat transfer to be significant. At $z'=\infty$, the fluid is at uniform temperature T/sub ∞/ such that T/sub 0/>T/sub ∞/. The

equations of motion under small perturbation theory reduce to a set of linear homogeneous equations with a variable coefficient subject to homogeneous boundary conditions when the unperturbed temperature is adopted as the independent variable. The solution is effected via a finite difference scheme and the Rayleigh number is determined by Newton's iterative method. (author). 8 refs.

44345 **(IC—88/55) Test theory of special relativity: What it is and why we need it.** Mansouri, R. (International Centre for Theoretical Physics, Trieste (Italy)). Mar 1988. 11p. NTIS (US Sales Only), PC A03/MF A01. Order Number DE88703533/JAW.

After a critical overview on the traditional way of expressing the accuracy of experiments testing the postulates of the special theory of relativity, the four-parameter test theory is briefly introduced. The existing experiments are then classified and their accuracies are expressed in terms of the parameter of the test theory. By changing the convention of synchronization of distant clocks, it is shown how different equivalent theories can be formulated. (author). 23 refs.

44346 **(IC—88/56) Black holes in string-generated gravity models.** Wiltshire, D.L. (International Centre for Theoretical Physics, Trieste (Italy)). Mar 1988. 31p. NTIS (US Sales Only), PC A03/MF A01. Order Number DE88703534/JAW.

Spherically symmetric solutions of d-dimensional Einstein-Maxwell theory with a Gauss-Bonnet term are classified. All spherically symmetric solutions of d-dimen ional Einstein gravity coupled to the Gauss-Bonnet and Born-Infeld terms are derived, classified and compared with the previous solutions. Thermodynamic properties of the black holes are discussed and the black hole temperatures derived. Unlike the solutions of the Einstein-Maxwell theory the solutions with a Born-Infeld term do not appear to have a stable endpoint with regard to thermal evaporation. (author). 63 refs, 3 figs, 1 tab.

44347 **(IC—88/71) Bundle representations of the tangent group of a Lie group.** Toomanian, M. (International Centre for Theoretical Physics, Trieste (Italy)). Apr 1988. 11p. NTIS (US Sales Only), PC A03/MF A01. Order Number DE88703536/JAW.

The aim is to define representations of the tangent group of a Lie group, when a representation of the Lie group is known. (author). 12 refs.

44348 **(IFVE-OTF—87-165) Gravitational radiation in relativistic theory of gravity with a nonzero graviton mass.** Vlasov, A.A.; Chugreev, Yu.V. (Gosudarstvennyj Komitet po Ispol'zovaniyu Atomnoj Ehnergii SSSR, Serpukhov. Inst. Fiziki Vysokikh Ehnergij). 1987. 7p. (In Russian). NTIS (US Sales Only), PC A02/MF A01. Order Number DE88703544/JAW.

Submitted to the journal Zh. Ehksp. Teor. Fiz. .

Radiation of gravitation waves have been analysed in the linear approximation of the relative theory of gravity, with the mass of graviton being nonzero. It is shown that the main contribution to the energy loss due to gravitational radiation has been described by the well-known quadrupole formula. Linear approximation applicability conditions have been analysed. 8 refs.

44349 **(IFVE-OTF—87-175) On integration of a two-dimensionalized system of self-dual equations of four-dimensional space.** Leznov, A.N.; Mukhtarov, M.A. (Gosudarstvennyj Komitet po Ispol'zovaniyu Atomnoj Ehnergii SSSR, Serpukhov. Inst. Fiziki Vysokikh Ehnergij). 1987. 7p. (In Russian). NTIS (US Sales Only), PC A02/MF A01. Order Number DE88703546/JAW.

Submitted to the journal J. Math. Phys. .

It is shown that integration of the two-dimensionalized system of the self-dual equations is equivalent to the solution of a system of the linear special integral equations with the Cauchy kernel. 5 refs.

44350 **(ITEP—197(1987)) Quasi-exactly-solvable problems and SL(2) group.** Turbiner, A.V. (Gosudarstvennyj Komitet po Ispol'zovaniyu Atomnoj Ehnergii SSSR, Moscow. Inst. Teoreticheskoj i Ehksperimental'noj Fiziki). 1987. 11p. NTIS (US Sales Only), PC A03/MF A01. Order Number DE88703626/JAW.

Recently discovered quasi-exactly-solvable problems of quantum mechanics are shown to be related to the existence of the finite-dimensional representations of the group SL(2). It is proved that bilinear forms h=a/sub ij/J/sup i/J/sup j/+b/sub i/J/sup i/ (J/sup i/ stand for the generators) allow one to greate a set of quasi-exactly-solvable problems of different types, including those that are already known. We get, in particular, problems in which the spectral Riemann surface containing infinite number of sheets is splitted off one or two finite-sheet pieces. It is noted that in the general case the transition h -> H=-d/sup 2//dx/sup 2/+V(x) is relaized with the aid of the elliptic functions. All known exactly-solvable problems with the known spectrum and factorized Riemann surface can be obtained in this approach. The dependence of the energy eigenvalue of the number of the level is quadratic in general. 5 refs.; 1 tab.

44351 **(JINR-E—2-87-707) Quantum interference on graphs controlled by an external electric field.** Exner, P.; Seba, P.; Stovices, P. (Joint Inst. for Nuclear Research, Dubna (USSR). Lab. of Theoretical Physics). 1987. 15p. NTIS (US Sales Only), PC A03/MF A01. Order Number DE88703686/JAW.

We consider motion of a charged quantum particle on a loop with two external leads which is placed into an electrostatic field. The loop Hamiltonian is chosen in the simplest possible way; in order to join it to the free Hamiltonians describing the leads, we employ a method based on self-adjoint extensions. Under a symmetry requirement, the resulting full Hamiltonian contains four free parameters; each junction is characterized by a pair of them. The system under consideration representes a model of metallic or semiconductor structures tha can be fabricated by presently available technologies. Assuming the ballistic regime for electrons in such a structure, we calculate the resitance dependence on intensity of the external field. The results suggest the possibility of constructing quantum interference transistors whose size and switching voltage would be much smaller than in the presently used microchips. 41 refs.; 4 figs.

44352 **(JINR-E—2-87-888) Problem of moments and the meaning of perturbation expansions in quantum physics.** Horzela, A. (Joint Inst. for Nuclear Research, Dubna (USSR). Lab. of Theoretical Physics). 1987. 12p. NTIS (US Sales Only), PC A03/MF A01. Order Number DE88703688/JAW.

Submitted to the journal J. Math. Phys. .

The methods of the classical moment theory are used to give the interpretation of the divergent perturbation expansions. The expansions with factorially growing coefficients are proved to be mathematically well defined objects which may be resummed using the Borel and Pade methods. The problem of uniqueness of the resummation is analysed and some conditions of the uniqueness are obtained. 17 refs.

44353 **(JINR-E—4-87-655) New perturbative treatment of pentadiagonal Hamiltonians.** Znojil, M. (Joint Inst. for Nuclear Research, Dubna (USSR). Lab. of Theoretical Physics). 1987. 12p. NTIS (US Sales Only), PC A03/MF A01. Order Number DE88703694/JAW.

A new formulation of the Rayleich - Schroedinger perturbation theory is proposed. It is inspired by a recurent construction of propagators, and its main idea lies in a replacement of the auxiliary matrix elements (generalized continued fractions) by their non-numerical approximants. In a test of convergence (the anharmonic oscillator), the asymptotic fixed-point approximation scheme is used. The results indicate a good applicability of this fixed-point version of our formalism to systems with a band-matrix structure of the Hamiltonian. 10 refs.; 3 tabs.

44354 **(JINR-E—5-87-634) Perturbation theory with the matrix continued fractions.** Znojil, M. (Joint Inst. for Nuclear Research, Dubna (USSR). Lab. of Theoretical Physics). 1987. 9p. NTIS (US Sales Only), PC A02/MF A01. Order Number DE88703696/JAW.

An idea of using the nondiagonal unperturbed Hamiltonians is further developed. We admit a band-matrix structure of H/sub 0/ and describe how the propagator R may be constructed in terms of the matrix continued fractions. The new perturbation is then described in more detail. Its numerical test employs the standard anharmonic oscillator example and shows a good applicability of the formalism, presumably to all the systems with a strong coupling between the neighbouring "unperturbed" orbitals. 9 refs.; 3 tabs.

44355 **(JINR-E—11-87-455) Implementation of Kovacic's algorithm for solving ordinary differential equations in FORMAC.** Zharkov, A.Yu. (Saratovskij Gosudarstvennyj Univ. (USSR)). (Joint Inst. for Nuclear Research, Dubna (USSR). Lab. of Computing Techniques and Automation). 1987. 5p. NTIS (US Sales Only), PC A02/MF A01. Order Number DE88703698/JAW.

An implementation of Kovacic's algorithm for finding Liouvillian solutions of the differential equations y'' + a(x)y' + b(x)y = 0 with rational coefficients a(x) and b(x) in the Computer Algebra System FORMAC is described. The algorithm description is presented in such a way that one can easily implement it in a suitable Computer Algebra System. 6 refs.

44356 **(JINR-E—17-87-29) Soliton-like bubbles in the system of interacting bosons.** Barashenkov, I.V.; Makhan'kov, V.G. (Joint Inst. for Nuclear Research, Dubna (USSR). Lab. of Computing Techniques and Automation). 1987. 10p. NTIS (US Sales Only), PC A02/MF A01. Order Number DE88703703/JAW.

Submitted to the journal Phys. Lett. A.

The PHI/sup 3/-PHI/sup 5/ NLS equation which arises as the meanfield approximation for the boson system with 2 and 3 body contact interactions is studied. The bubble-like soliton solutions are found in 1, 2 and 3 dimensions and their stability is examined. 14 refs.; 2 figs.

44357 **(JINR-E—17-87-778) On the partition function of d+1 dimensional kink-bearing systems.** Radosz, A.; Salejda, W. (Joint Inst. for Nuclear Research, Dubna (USSR). Lab. of Theoretical Physics). 1987. 6p. NTIS (US Sales Only), PC A02/MF A01. Order Number DE88703708/JAW.

It is suggested that the problem of finding a partition function of d+1 dimensional kink-bearing system in the classical approximation may be formulated as an eigenvalue problem of an appropriate d dimensional quantum. 7 refs.

44358 **(JINR-R—2-86-686) Relativistically invariant adjustment of space-time interval in inertial systems of reference.** Zorin, G.N. (Joint Inst. for Nuclear Research, Dubna (USSR). Lab. of Nuclear Problems). 1986. 16p. (In Russian). NTIS (US Sales Only), PC A03/MF A01. Order Number DE88703724/JAW.

The analysis is made on the Einstein synchronization of watches and the Reichenbach coefficient in the framework of generalization of special relativity theory in accordance with the de Broglie corpuscular-wave dualism. The Poincare and Einstein points of view on scales and watch in the special relativity theory are discussed. Relativistically invariant adjustment of space-time interval in inertial system of reference according to space-time unity is suggested. 15 refs.

44359 **(JINR-R—2-87-643) On a permissible anisotropy of space-time.** Strel'tsov, V.N. (Joint Inst. for Nuclear Research, Dubna (USSR). Lab. of High Energy). 1987. 10p. (In Russian). NTIS (US Sales Only), PC A02/MF A01. Order Number DE88703729/JAW.

Conventional character of the concept of simultaneity and distance in a special relativity theory is discussed. Lorentz-Edwards transformations are considered taking into account explicity allowable time anisotropy. Permissible experimentally space anisotropy is introduced by the "gauge" transformation of space coordinate in the Lorentz formulae. Finally a possibility of introduction of anisotropic space-time within the stated conventions is considered. Corresponding generalized Lorentz transformations, expressions for one-way velocities, "right" and "left" distances for material bodies etc. are obtained. The possibility to generalize the Lobachevsky geometry over anisotropic space of velocities is also discussed. 15 refs.; 1 fig.

44360 **(JINR-R—2-87-696) On substantiation of kinetic equations in the theory of nuclear reactions. On existing substantiation of the kinetic equations.** Kostenko, B.F. (Joint Inst. for Nuclear Research, Dubna (USSR). Lab. of Computing Techniques and Automation). 1987. 11p. (In Russian). NTIS (US Sales Only), PC A03/MF A01. Order Number DE88703733/JAW.

Arguments against the existing substantiation of kinetic equations in the theory of nuclear reactions are adduced. In particular, it is shown that the averaging over particle energies in accelerator beam and over the errors of experimental devices are non-adequate for deducing kinetic equations. Some other inaccuracies in the existing substantiation are pointed out. 31 refs.

44361 **(JINR-R—2-87-697) On substantiation of kinetic equations in the theory of nuclear reactions. The role of physical process of information transmission. Pseudochaos.** Kostenko, B.F. (Joint Inst. for Nuclear Research, Dubna (USSR). Lab. of Computing Techniques and Automation). 1987. 16p. (In Russian). NTIS (US Sales Only), PC A03/MF A01. Order Number DE88703734/JAW.

A scheme of deducing the kinetic equations in the theory of nuclear reactions differing from the existing one are proposed. The main physical hypotheses are: a) existence of the pseudochaotic dynamical evolution of the system; b) availability of transmission of information on surrounding of the physical system. The substantiation of the kinetic equations in contrast to existing one is in agreement with the conception of detection of events in atomic nuclei which is developed in connection with the problem of experimental investigation of events at small-time distances. 22 refs.; 2 figs.

44362 **(JINR-R—2-87-737) Nonintegrable effects in classical three-particle problem on the line.** Fiziev, P.P.; Mishonov, T.M.; Fizieva, Ts.Ya. (Joint Inst. for Nuclear Research, Dubna (USSR). Lab. of Theoretical Physics). 1987. 20p. (In Russian). NTIS (US Sales Only), PC A03/MF A01. Order Number DE88703735/JAW.

Submitted to the Organizing Comittee of 8. International conference on quantum field theory problems, Alushta, Oct. 1987.

Three-particle problem of straight line with homogeneous potentials which have the form V=rho/sup n/α(phi) in hyperspherical coordinates is considered. This class of potentials includes the systems with two-particle Newton, Coulomb, Calogero, oscillator and other interactions. Some of these problems are Bour-Liouville ingrable, others are not. New analytical system of first order differential equations for trajectory on the isoenergy surface is investigated. It is shown that a nearly all values of masses or charges of particles all additional first integrals of Newton and Coulomb three-particle problems are infinite-valued functions. As a consequence, in these nonintegrable problems there exists three-particle resonance (bound state with finite) life time), reactions with ot without particle exchange etc. Such effects are not possible in Bour-Liouville integrable systems because of unambigousity of their first integrals. 24 refs.; 12 figs.

44363 **(JINR-R—2-87-868) Exact solutions of the Korteweg-de Vries equation with a self-consistent source.** Mel'nikov, V.K. (Joint Inst. for Nuclear Research, Dubna (USSR). Lab. of Theoretical Physics). 1987. 10p. (In Russian). NTIS (US Sales Only), PC A02/MF A01. Order Number DE88703740/JAW.

Submitted to the journal Phys. Lett., A.

Exact solutions are found for the Korteweg-de Vries equation with a source satisfying the stationary Schroedinger equation. Each solution describes the evolution of the initial moving wave with one phase velocity to the final wave with another phase velocity. The conditions are pointed out under which the phase ve-

locities of these waves may differ in sign. The obtained results are relevant to some problems of hydrodynamics, plasma physics, solid state physics, etc. 7 refs.

44364 **(JINR-R—4-87-878) New method to solve the one-dimensional Schroedinger equation.** Ignatovich, V.K. (Joint Inst. for Nuclear Research, Dubna (USSR). Lab. of Neutron Physics). 1987. 4p. (In Russian). NTIS (US Sales Only), PC A02/MF A01. Order Number DE88703747/JAW.

The potential in the Schroedinger equation is divided by infinitesimal narrow gaps on separate potential barriers. The tops of these barriers are approximated by the second-order polynomials. The inside wave function and reflection and transmission amplitudes are obtained for every barrier separately. After that the recurrent relations are used to present the reflection amplitude for the total potential in the chain fraction form in terms of partial barrier amplitudes. The transmission amplitude and the wave function at any point inside the potential are constructed in the same way. 4 refs.; 1 fig.

44365 **(JINR-R—5-87-766) Analogs of Clifford algebra for forms above quadratic and their matrix realization.** Yamaleev, R.M. (Joint Inst. for Nuclear Research, Dubna (USSR). Lab. of Computing Techniques and Automation). 1987. 8p. (In Russian). NTIS (US Sales Only), PC A02/MF A01. Order Number DE88703748/JAW.

Matrix representations for generators of algebra with multilinear anticommutation relations inducible by N(M)-form are found. Algorithm for construction of matrix-generator is proposed and a theorem is proved about the correspondence of algorithm and roles of multilinear anticommutation relations. The obtained matrices have characteristics analogous to the properties of basic matrices of Clifford algebra. 9 refs.

44366 **(JINR-R—11-87-721) Finite-difference methods for solution of the many-dimensional nonlinear Schroedinger equation.** Panova, E.Yu.; Shvachka, A.B. (Joint Inst. for Nuclear Research, Dubna (USSR). Lab. of Computing Techniques and Automation). 1987. 10p. (In Russian). NTIS (US Sales Only), PC A02/MF A01. Order Number DE88703772/JAW.

The brief review of the finite-difference methods used to solve the many-dimensional nonlinear Schroedinger equation is presented. The features of two- and three-point finite-difference schemes are discussed, including their nonconservation property. The properties of the local one-dimensional scheme proposed by the authors are investigated, and it is shown that the scheme is economical and conservative. To illustrate the efficiency of the schemes the results of the numerical investigation of the many-dimensional Schroedinger equation with logarithmic nonlinearity are presented. 19 refs.; 1 tab.

44367 **(JINR-R—11-87-722) Numerical schemes in the stabilization method for nonlinear differential equations of second order.** Zhanlav, T.; Puzynin, I.V. (Joint Inst. for Nuclear Research, Dubna (USSR). Lab. of Computing Techniques and Automation). 1987. 19p. (In Russian). NTIS (US Sales Only), PC A03/MF A01. Order Number DE88703773/JAW.

The stabilization method is used for solving nonlinear differential equations of second order. One sufficient condition of a solution is given. Computational scheme is based on the continuous analog of the Newton method and spline-collacation method. The convergence of iterative procedure and of approximate solution are proved. The efficiently of the constructed algorithm is illustrated by numerical examples. 11 refs.; 1 fig.; 12 tabs.

44368 **(RRK—88-3) Interacting membrane picture in the light-cone gauge.** Fujikawa, Kazuo. (Hiroshima Univ., Takehara (Japan). Research Inst. for Theoretical Physics). Jan 1988. 16p. NTIS (US Sales Only), PC A03/MF A01. Order Number DE88753435/JAW.

An attempt is made to formulate the interacting membrane picture in the light-cone gauge, which is analogous to the interacting string picture of Mandelstam. The possible emission of strings from the membrane is also discussed.

44369 **(SAND—87-1432) SHED: A program for three-dimensional, rigid body, shroud ejection dynamics.** Segalman, D.J. (Sandia National Labs., Albuquerque, NM (USA)). Mar 1988. Contract AC04-76DP00789. 43p. NTIS, PC A03/MF A01; 1; GPO Dep. Order Number DE88012410/JAW.

The computer program SHED (for SHroud Ejection Dynamics) which calculates the exoatmospheric trajectory of a missile shroud is described. This rigid body dynamics program follows the motion of the shroud as its motors accelerate it ahead and away form the missile. Of particular interest is the ability of SHED to accommodate the forces produced by the motors which are "fixed" to the body in the sense that they both translate and rotate along with the body. The code as written has the following capabilities: The resulting program can accommodate an arbitrary number of motors, arranged in an arbitrary manner on the shroud, and each imposing an arbitrary schedule of thrust; The shroud may have any arbitrary shape; and Guides can be accommodated which protect the payload by preventing shroud rotation or lateral motion until the shroud has passed over the guide. Limitations are that all bodies are assumed to be rigid and aerodynamic loads are not included. SHED has proven itself sufficiently robust and versatile to permit a critical comparison of a large range of shroud separation strategies in selecting a separation strategy for the Strategic TARgeting System (STARS) funded by the Army SDI Office. 8 refs., 9 figs.

44370 **(UCID—21285) MAXWELL3: A 3D finite element electromagnetic modeling code.** Grant, J.B. (Lawrence Livermore National Lab., CA (USA)). 15 Apr 1988. Contract W-7405-ENG-48. 41p. NTIS, PC A03/MF A01;1; GPO Dep. Order Number DE88010602/JAW.

The simulation of electromagnetic coupling and scattering has grown in importance in recent years due to the vulnerability of integrated circuits to EMI. More specifically, there is a need for simulating electromagnetic scattering from, and coupling to, three dimensional objects. To satisfy the need for accurate, time domain modeling of 3D electromagnetic coupling and scattering MAXWELL3 was developed. The numerical method chosen requires the discretization of the model with a mesh generator. MAXWELL3 then uses the mesh and computes the time domain electric and magnetic fields by integrating Maxwell's curl equations. The output from MAXWELL3 can then be used with a post processor to get the desired information in a graphical form. MAXWELL3 is a linear, time domain, finite element code designed for simulation of electromagnetic fields interacting with three dimensional objects. The discretized model is defined by a collection of homogeneous, isotropic hexahedral elements (six faced, eight noded bricks) which need not correspond to a logically regular grid. Because the elements are not restricted to rectangular boxes, the problem space boundaries and interior surfaces can be of arbitrary shape.

44371 **Adiabatic processes in monatomic gases.** Carrera-Patino, M.E. (Department of Chemistry, The University of Chicago, Chicago, Illinois 60637). *Journal of Chemical Physics;* **89**: No. 4, 2271-2277(15 Aug 1988).

A kinetic model is used to predict the temperature evolution of a monatomic ideal gas undergoing an adiabatic expansion or compression at a constant finite rate, and it is then generalized to treat real gases. The effects of interatomic forces are considered, using as examples the gas with the square-well potential and the van der Waals gas. The model is integrated into a Carnot cycle operating at a finite rate to compare the efficiency's rate-dependent behavior with the reversible result. Limitations of the model, rate penalties, and their importance are discussed.

44372 **Generalized Gaussian wave packet dynamics, Schroedinger equation, and stationary phase approximation.** Huber, D.; Heller, E.J.; Littlejohn, R.G. (Department of Chemistry BG-10, University of Washington, Seattle, Washington 98195). *Journal of Chemical Physics;* **89**: No. 4, 2003-2014(15 Aug 1988).

We have recently published a new semiclassical method, generalized Gaussian wave packet dynamics, which extends Gaussian wave packet dynamics into complex phase space. Although we were able to give an accurate formulation of the method, we had at the time of writing that paper only an intuitive, heuristic understanding of the deeper causes which make the method work. A more mathematical understanding was needed. To close this gap we show in this paper the equivalence of the new method with a first order expansion of $(h/2\pi)$ of the Schroedinger equation. We further prove that the new method is equivalent to the stationary phase approximation, using the usual WKB formula for the propagator. The latter equivalence enables us to show that all the symmetry properties of time-dependent quantum mechanics also hold in the new semiclassical theory. Finally, we provide some elaboration of the method, and clarify several issues that were not discussed before. With this new insight we are able to formulate a simple rule for the calculation of semiclassical wave functions that contain contributions from more than one branch. This corrects for the divergence of semiclassical wave functions near caustics, a problem that we encountered in the preceding paper.

44373 **Monte Carlo path integration for the real time propagator.** Makri, N.; Miller, W.H. (Department of Chemistry, University of California, and Materials and Chemical Sciences Division, Lawrence Berkeley Laboratory, Berkeley, California 94720). *Journal of Chemical Physics;* **89**: No. 4, 2170-2177(15 Aug 1988).

Monte Carlo methods are described for evaluating the Feynman path integral representation of the (real time) propagator (time evolution operator), exp(-iHt/(h/2π)). The approach is based on the modified Filinov algorithm presented earlier by Makri and Miller [Chem. Phys. Lett. 139, 10 (1987)]. Numerical calculations are presented for time evolution in a symmetric double well potential, as well as in a Morse potential.

44374 **Linear birefringence effects on fiber-optic current sensors.** Forman, P.R.; Jahoda, F.C. (Los Alamos National Laboratory, Los Alamos, New Mexico 87545). *Applied Optics;* **27**: No. 15, 3088-3096(1 Aug 1988).

The occurrence of linear birefringence is inevitable when dealing with fiber optics. Intrinsic birefringence can be minimized, but deploying the fiber on an experiment will introduce stress birefringence due to bending and pressure. We have studied the effects of this extraneous linear birefringence on the measurement of current-induced circular birefringence in a fiber which also has a strong twist circular birefringence bias. Orienting the analyzing polarizer by a proscribed procedure gives minimum error. Quantitative error limits on the current for given fiber coil radii and winding tensile stress are calculated. Additional restrictions on the fiber lead-in and lead-out sections are discussed.

44375 **Topological and metric properties of Henon-type strange attractors.** Cvitanovic, P.; Gunaratne, G.H.; Procaccia, I. (Niels Bohr Institute, Blegdamsvej 17, DK-2100 Copenhagen, Denmark). *Physical Review [Section] A: General Physics;* **38**: No. 3, 1503-1520(1 Aug 1988).

We use the set of all periodic points of Henon-type mappings to develop a theory of the topological and metric properties of their attractors. The topology of a Henon-type attractor is conveniently represented by a two-dimensional symbol plane, with the allowed and disallowed orbits cleanly separated by the "pruning front." The pruning front is a function discontinuous on every binary rational number, but for maps with finite dissipation chemical bondbchemical bond<1, it is well approximated by a few steps, or, in the symbolic dynamics language, by a finite grammar. Thus equipped with the complete list of allowed periodic points, we reconstruct (to resolution of order b/sup n/) the physical attractor by piecing together the linearized neighborhoods of all periodic points of cycle length n. We use this representation to compute the singularity spectrum f(α). The description in terms of periodic points works very well in the "hyperbolic phase," for α larger than some α/sub c/, where α/sub c/ is the value of α corresponding to the (conjectured) phase transition.

44376 **Lowest modes of a bottle.** Crawford, F.S. (Physics Department and Lawrence Berkeley Laboratory, University of California, Berkeley, California 94720). *American Journal of Physics;* **56**: No. 8, 702-712(Aug 1988).

Helmholtz's model predicts correctly the frequency of the lowest mode of a bottle. A simple generalization of Helmholtz's model correctly predicts this mode and also the next few modes: "flute modes": of flasks with long uniform necks but arbitrarily shaped bodies. Wine bottles have additional low-frequency "cavity modes" that require a further easy generalization. For a bottle with slowly varying cross section an additional generalization can be made that retains the one-dimensional (1-D) character of the previous models and gives results that are in good agreement with experiment for the lowest mode: the "diametral mode": of a hollow sphere. For higher modes of a sphere, the 1-D model is inadequate and must be discarded in favor of exact solutions of the 3-D wave equation.

44377 **Culvert whistlers revisited.** Crawford, F.S. (Physics Department and Lawrence Berkeley Laboratory, University of California, Berkeley, California 94720). *American Journal of Physics;* **56**: No. 8, 752-754(Aug 1988).

A geometric explanation is given for the culvert whistler demonstration. The method is applied to the echo tube at the San Francisco Exploratorium. (AIP)

44378 **Polynomials and operator orderings.** Bender, C.M.; Dunne, G.V. (The Blackett Laboratory, Imperial College, London SW7 2BZ, United Kingdom). *Journal of Mathematical Physics (New York);* **29**: No. 8, 1727-1731(Aug 1988).

It is shown that there is an exact one-to-one correspondence between all possible sets of polynomials (both orthogonal and nonorthogonal) and rules for operator orderings. Operator orderings that are Hermitian give polynomials with definite parity. Most of the standard classical orthogonal polynomials are associated with operator orderings that are not particularly simple. However, there is a special one-parameter class of Hermitian operator orderings that corresponds to a class of elegant but little-known orthogonal polynomials called continuous Hahn polynomials.

44379 **Geometrical classification scheme for weights of Lie algebras.** Capps, R.H. (Department of Physics, Purdue University, West Lafayette, Indiana 47907). *Journal of Mathematical Physics (New York);* **29**: No. 8, 1732-1735(Aug 1988).

Every weight of a Lie algebra belongs to one particular Weyl orbit. The depth within an orbit has been defined as the minimum number of Weyl reflections associated with simple roots that are necessary to transform the weight into the dominant weight of the orbit. A simple set of classification parameters that measures the depth and distinguishes between different weights of the same depth is introduced. The parameters are geometrical in that they are related directly to the orientation of the weight vector. They correspond to a particular member of the Weyl group that transforms the weight into the dominant weight. A simple rule is given for listing all the weights of an orbit in terms of the parameters.

44380 **Global anomalies and algebraic topology.** Lundell, A.T.; Tosa, Y. (Department of Mathematics, University of Colorado, Campus Box 426, Boulder, Colorado 80309). *Journal of Mathematical Physics (New York);* **29**: No. 8, 1795-1806(Aug 1988).

The algebraic topology aspect of the global pure gauge anomaly calculation is investigated. In particular, the use of a cohomology sequence clarifies the method initiated by Witten [Nucl. Phys. 223, 422, 433 (1983)] and Elitzur and Nair [Nucl. Phys. B 243, 205 (1984)]. Examples in SU(N), Sp(N), and SO(N) are discussed.

44381 **Wormholes and Goldstone bosons.** Lee, K. (Theoretical Physics Group, Fermi National Accelerator Laboratory, P.O. Box 500, Batavia, Illinois 60510). *Physical Review Letters;* **61**: No. 3, 263-266(18 Jul 1988).

The quantum theory of a complex scalar field coupled to gravity is considered. A formalism for the semiclassical approach in Euclidean time is developed and used to study wormhole physics. The conserved global charge plays an essential role. Wormhole physics turns on only after the symmetry is spontaneously broken. An effective self-interaction for Goldstone bosons due to wormholes and child universes is shown to be a cosine potential, whose vacuum energy will be reduced by the cosmic expansion. Some implications and questions are discussed.

44382 **Quantum electrodynamics of optical activity in birefringent crystals.** Eimerl, D. (Lawrence Livermore National Laboratory, P.O. Box 5508, L-490, Livermore, California 94550). *Journal of the Optical Society of America B: Optical Physics;* 5: No. 7, 1453-1461(Jul 1988).

Quantum electrodynamics (QED) is applied for the first reported time to optical rotation in birefringent crystals. Using a modification of QED appropriate to anisotropic crystals together with general space—time symmetries, we derive the optical-rotation component of the photon propagator. We also derive a low-frequency theorem for the optical-rotation tensors that is valid to all orders in perturbation theory. We prove that optical activity depends in a nonlinear manner on the direction of propagation and is approximately proportional to the optical frequency. Earlier theories of optical rotation, which are primarily phenomenological, are either inconsistent with QED or are developed only for isotropic crystals. The relation among the QED predictions, the constitutive equations, and earlier approaches is fully discussed.

44383 **Semiclassical physics and quantum fluctuations.** Boucher, W.; Traschen, J. (Enrico Fermi Institute, University of Chicago, Chicago, Illinois 60637). *Physical Review [Section] D: Particles and Fields;* 37: No. 12, 3522-3532(15 Jun 1988).

We investigate theories in which classical and quantum-mechanical degrees of freedom interact dynamically. In commonly used semiclassical theories, such as those used to study inflationary-universe models, quantum fluctuations do not affect the dynamics of the classical variables. We construct a new semiclassical theory in which the quantum and classical fluctuations do affect each other; the Wigner probability function turns out to be a special case. Relevance to calculations of perturbations from inflation are discussed.

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44384 **(ANL/FPP/TM—223) Eddy current analysis in fusion devices.** Turner, L.R. (Argonne National Lab., IL (USA)). Jun 1988. Contract W-31109-ENG-38. 17p. NTIS, PC A03/MF A01; 1; GPO Dep. Order Number DE88013326/JAW.

In magnetic fusion devices, particularly tokamaks and reversed field pinch (RFP) experiments, time-varying magnetic fields are in intimate contact with electrically conducting components of the device. Induced currents, fields, forces, and torques result. This note reviews the analysis of eddy current effects in the following systems: Interaction of a tokamak plasma with the eddy currents in the first wall, blanket, and shield (FWBS) systems; Eddy currents in a complex but two-dimensional vacuum vessel, as in TFTR, JET, and JT-60; Eddy currents in the FWBS system of a tokamak reactor, such as NET, FER, or ITER; and Eddy currents in a RFP shell. The cited studies are chosen to be illustrative, rather than exhaustive. 42 refs.

44385 **(CEA-CONF—9187) Application of enhanced scattering near the cutoff layer to localize drift wave.** Simonet, F. (Association Euratom-CEA, Centre d'Etudes Nucleaires de Cadarache, 13 - Saint-Paul-lez-Durance (France). Dept. de Recherches sur la Fusion Controlee). 1987. 3p. (CONF-870629—). NTIS (US Sales Only), PC A02/MF A01. Order Number DE88753891/JAW.

From 14. European conference on controlled fusion and plasma physics; Madrid, Spain (22 Jun 1987).

The aim of standard IR or FIR scattering experiments is the accessibility of a given density fluctuations wavenumber but with averaging over large scattering/volume. A complementary experiment spatially localized but which cannot resolve the fluctuations wavenumber would be very useful to well determine the dispersion relation and the spatial location of small scale fluctuations in a fusion plasma. The main idea of our work is to use the properties of an incident wave near the plasma layers where the transmission is no more possible (contrary to the usual scattering investigation where the incident wave transmits freely through the plasma. We have studied the possibility of enhanced scattering at the cutoff layer where the index of refraction vanishes (wave frequency equal to the plasma frequency).

44386 **(CEA-CONF—9188) Modification of the coupling of lower hybrid waves by means of movable limitors on Petula B.** Goniche, M.; David, C.; Rey, G.; Tonon, G. (Association Euratom-CEA, Centre d'Etudes Nucleaires de Cadarache, 13 - Saint-Paul-lez-Durance (France). Dept. de Recherches sur la Fusion Controlee). 1987. 4p. (CONF-870629—). NTIS (US Sales Only), PC A02/MF A01. Order Number DE88753892/JAW.

From 14. European conference on controlled fusion and plasma physics; Madrid, Spain (22 Jun 1987).

Two graphite plates were installed on each side of the grill mounted on the tokamak Petula B. This gril, previously described is composed of 3 modules of 6 waveguides each and is operated at 3.7Ghz for current drive studies. These plates, independently motor driven, can be radially moved forward and act as secondary limitors (SL), allowing the density at the mouth of the gril to be lowered.

44387 **(DOE/DP/40200—67) Long-time simulation of the single-mode bump-on-tail instability.** Simon, A.; Radin, S.; Short, R.W. (Rochester Univ., NY (USA). Lab. for Laser Energetics). Jan 1988. Contract FC08-85DP40200. 60p. NTIS, PC A04/MF A01;1; GPO Dep. Order Number DE88008441/JAW.

A Vlasov code was modified and used to study long-time behavior of the single-mode bump-on-tail instability. Large oscillations which interrupted his original runs at $\omega_0 T \sim 1300$ were identified and controlled by heating of the cold background electrons. A run to $\omega_0 T = 30{,}000$ showed saturation at about the level predicted by Simon and Rosenbluth, before oscillations set in. A run with warmer background electrons was again interrupted by oscillations. A weakly unstable case was followed to $\omega_0 T = 60{,}000$ and saturated at much lower amplitude. In all cases, the velocity distribution developed strong ripples near $v = 0$. These are shown to be due to a numerical grid effect, and may be responsible for the oscillations and for the low level of saturation in the weakly unstable case. 7 refs., 30 figs., 2 tabs.

44388 **(DOE/ER/13553—2) Non-local kinetic transport studies of a field-reversed configuration. Annual technical report, July 1, 1987-June 30, 1988.** Choi, C.K. (Purdue Univ., Lafayette, IN (USA). School of Nuclear Engineering). 1988. Contract FG02-87ER53250. 63p. NTIS, PC A04/MF A01; 1; GPO Dep. Order Number DE88012397/JAW.

The Field Reversed Configuration (FRC) is a type of plasma experiment of current interest in fusion research. The life of an FRC can be divided into two periods, a highly dynamic formation phase followed by a quiescent equilibrium phase. The FRC can be a viable source of fusion energy only if the confinement properties of the equilibrium phase are sufficient for breakeven. The purpose of this report is to provide the FRC theory community with equi-

librium models that have been found to be useful. Three equilibrium models are presented: a kinetic model, a rigidly rotating model, and an MHD model.

44389 **(DOE/ET—53088-323) Exact and almost exact solution to Vlasov-Maxwell system.** Mahajan, S.M. (Texas Univ., Austin (USA). Inst. for Fusion Studies). Jun 1988. Contract FG05-80ET53088. 44p. (IFSR—323). NTIS, PC A03/MF A01; 1; GPO Dep. Order Number DE88013561/JAW.

Exact and almost exact solutions to the Vlasov-Maxwell systems describing a variety of plasma configurations with density, temperature and current gradients, are presented. Possible consequences of these solutions are also discussed. 6 refs., 8 figs.

44390 **(DOE/ET—53088-328) Effect of scalar nonlinearity on the dipole vortex solution.** Su, X; Horton, W.; Morrison, P.J.; Pavlenko, V.P. (Texas Univ., Austin (USA). Inst. for Fusion Studies). Jul 1988. Contract FG05-80ET53088. 23p. (IFSR—328). NTIS, PC A03/MF A01; 1; GPO Dep. Order Number DE88013559/JAW.

The dipole vortex solutions of the Hasegawa-Mima drift wave or equivalently, the quasi-geostrophic Rossby wave equation are shown to be split up into long-lived monopole vortices (cyclones and anticyclones) in the presence of a small scalar, i.e. KdV type, nonlinearity. The lifetime of the dipole vortex varies inversely with the strength of the scalar nonlinearity. 12 refs., 4 figs.

44391 **(DOE/ET/51013—250) Hot electron plasma equilibrium and stability in the Constance B mirror experiment.** Chen, Xing. (Massachusetts Inst. of Tech., Cambridge (USA). Plasma Fusion Center). Apr 1988. Contract AC02-78ET51013. 175p. (PFC/RR—88-6). NTIS, PC A08/MF A01; 1; GPO Dep. Order Number DE88013935/JAW.

An experimental study of the equilibrium and macroscopic stability property of an electron cyclotron resonance heating (ECRH) generated plasma in a minimum-B mirror is presented. The Constance B mirror is a single cell quadrupole magnetic mirror in which high beta ($\beta \leqq 0.3$) hot electron plasmas (T/sub e/≅400 keV) are created with up to 4 kW of ECRH power. The plasma equilibrium profile is hollow and resembles the baseball seam geometry of the magnet which provides the confining magnetic field. This configuration coincides with the drift orbit of deeply trapped particles. The on-axis hollowness of the hot electron density profile is 50 {+-} 10%, and the pressure profile is at least as hollow as, if not more than, the hot electron density profile. The hollow plasma equilibrium is macroscopically stable and generated in all the experimental conditions in which the machine has been operated. The hollowness of the plasma pressure profile is not limited by the marginal stability condition. Small macroscopic plasma fluctuations in the range of the hot electron curvature drift frequency sometimes occur but their growth rate is small (ω/sub i//ω/sub r/ $\leqq 10^{-2}$) and saturate at very low level (δB/{bar B} $\leqq 10^{-3}$). Particle drift reversal is predicted to occur for the model pressure profile which best fits the experimental data under the typical operating conditions. No strong instability is observed when the plasma is near the drift reversal parameter regime, despite a theoretical prediction of instability under such conditions. The experiment shows that the cold electron population has no stabilizing effect to the hot electrons, which disagrees with current hot electron stability theories and results of previous maximum-B experiments. A theoretical analysis using MHD theory shows that the compressibility can stabilize a plasma with a hollowness of 20--30% in the Constance B mirror well. 57 refs.

44392 **(DOE/ET/53088—319) Initial evolution of nonlinear magnetic islands in high temperature plasmas.** Kotschenreuther, M. (Texas Univ., Austin (USA). Inst. for Fusion Studies). Jun 1988. Contract FG05-80ET53088. 14p. NTIS, PC A03/MF A01; 1; GPO Dep. Order Number DE88012346/JAW.

The evolution of nonlinear magnetic islands is computed in the kinetic collisionality regime called the semicollisional regime, which is appropriate to present fusion confinement devices. Realistic effects are included, such as the presence of small external field errors, radial electric fields, and omega. When present simultaneously, these effects can greatly change the stability of small amplitude nonlinear islands. Islands with $\Delta' > 0$ can sometimes be prevented from growing to macroscopic size; it is also possible to produce moderate mode-number nonlinear instabilities in the plasma edge. Furthermore, island growth can be prevented by application of external fields with suitably chosen amplitude and frequency.

44393 **(GA-A—19292) Recycling and neutral transport in the DIII-D Tokamak.** Allen, S.L.; Rensink, M.E.; Hill, D.N.; Perkins, D.E.; Jackson, G.L.; Mahdavi, M.A. (General Atomics Co., San Diego, CA (USA)). Apr 1988. Contract AC03-84ER51044. 35p. (CONF-880512—7). NTIS, PC A03/MF A01; 1; GPO Dep. Order Number DE88012428/JAW.

From 8. international conference on plasma surface interactions in controlled fusion devices; Julich, F.R. Germany (2 May 1988).

Several diagnostics have been used to characterize the edge plasma in the DIII-D divertor region and thereby to understand the particle recycling and neutral particle transport in an open divertor. An array of Langmuir probed mounted on the carbon divertor plates determines that generally the electron temperature is low (T/sub e/ ≅ 10-20 eV), and the electron density is high (n/sub e/ ≅ 5 {times} 10^{19} m/sup {minus 3}/). The edge plasma temperature and density are also measured by a movable Langmuir probe mounted at the midplane of the plasma; the data from these shot-by-shot edge radial scans are then connected with the data for the core plasma obtained by Thomson scattering. The heat flux to the divertor plates is measured by an absolutely calibrated infrared camera; a plasma model is used to compare the heat flux with the measured T/sub e/ and n/sub e/. The molecular neutral pressure at the edge of the plasma at several poloidal and toroidal locations is obtained from absolutely-calibrated pressure gauges; a gas puff enables in-situ gauge calibrations before each plasma shot. Typically, the divertor pressure is 10-50 times larger than that at the midplane. Time-resolved H/sub α/ brightness measurements are obtained from an absolutely calibrated television camera viewing the divertor region from above; both strike points are viewed simultaneously. The emission from the inner and outer strike points are usually equal after the H-mode transition, but are often unequal after the first ELM in H-mode and during some phases of L-mode discharges. A tangential camera measures the falloff in emission from the X-point to the plasma midplane. 26 refs., 8 figs., 1 tab.

44394 **(GTFR—83) Extension of the theory for neutral beam driven currents in tokamaks.** Stacey, W.M.; Mandrekas, J. (Georgia Inst. of Tech., Atlanta (USA). Fusion Research Center). Jun 1988. Contract AS05-78ET52025. 25p. NTIS, PC A03/MF A01; 1; GPO Dep. Order Number DE88012396/JAW.

A self-consistent theory is presented for the calculation of neutral beam driven currents in tokamaks, including for the first time the effects of radial transfer of toroidal momentum, background ion rotation, and fast beam ion pressure gradients. The new theory contains the beam current, electron return current with trapping effects, and the bootstrap current contributions of previous theories, but extended to be consistent with particle and momentum balance and ambipolarity in a rotating plasma with the radial transfer of toroidal momentum and a significant fast beam ion population. It is found that these new effects can be significant. TFTR model problem calculations indicate that the beam driven current can be reduced by as much as 30% and the bootstrap current can be increased by as much as 100%, relative to predictions based on the standard theory.

44395 **(HIFT—139) Anomalous bootstrap current due to drift waves.** Itoh, Sanae; Itoh, Kimitaka. (Hiroshima Univ. (Japan). Inst. for Fusion Theory). Jul 1987. 12p. NTIS (US Sales Only), PC A03/MF A01. Order Number DE88753406/JAW.

An anomalous parallel current driven by radial flux in tokamak is discussed. Drift waves, which cause an anomalous cross field diffusion, can generate a parallel current in a sheared magnetic field, if the fluctuation level has radial dependence.

44396 (HIFT—141) Model of H/L transition in tokamak. Itoh, Sanae; Itoh, Kimitaka. (Hiroshima Univ. (Japan). Inst. for Fusion Theory). Oct 1987. 16p. NTIS (US Sales Only), PC A03/MF A01. Order Number DE88753408/JAW.

New model of the L/H transition in tokamak plasmas is presented. Nonambipolar particle losses determine the consistent radial electric field near the plasma periphery. "Cusp type catastrophe" in the space of the radial electric field, particle flux and edge gradients is found. At the transition condition, plasma loss can take multiple values for one profiles of density/temperature near the edge. Critical edge condition is obtained.

44397 (HIFT—142) Detached and attached plasma in stellarators. Itoh, K.; Itoh, S. (Hiroshima Univ. (Japan). Inst. for Fusion Theory). Nov 1987. 22p. NTIS (US Sales Only), PC A03/MF A01. Order Number DE88753409/JAW.

Detached and attached plasmas in stellarators are studied. The energy balance equation in the peripheral plasma is solved by use of a simple model of the radiation loss. Criterion for the detached/attached plasma is obtained. The relation with the density limit is also discussed.

44398 (HIFT—143) Perspectives on low-aspect-ratio torsatron/heliotron. Itoh, Sanae; Itoh, Kimitaka; Cary, J.R. (Hiroshima Univ. (Japan). Inst. for Fusion Theory). Dec 1987. 21p. NTIS (US Sales Only), PC A03/MF A01. Order Number DE88753410/JAW.

The advantages of the low-aspect-ratio torsatron/heliotron configuration is discussed from the point of view of plasma confinement. Recent numerical results on the configuration study and the experimental data base are reviewed.

44399 (IAE—4506/6) Electron-viscosity and semicollisional drift-resistive ballooning modes in a tokamak. Kuvshinov, B.N.; Lakhin, V.P.; Mikhajlovskij, A.B.; Novakovskij, S.V.; Churikov, A.P.; Sharapov, S.E. (Gosudarstvennyj Komitet po Ispol'zovaniyu Atomnoj Ehnergii SSSR, Moscow. Inst. Atomnoj Ehnergii). 1987. 27p. (In Russian). NTIS (US Sales Only), PC A03/MF A01. Order Number DE88703510/JAW.

The role of electron viscosity in drift-resistive ballooning modes of tokamak with high pressure plasma is investigated theoretically. Mean ballooning equation in resistive layer, considering the effects mentioned, is obtained. It is shown, that at high viscosity this equation has exact analytical solution. General dispersion equation for the considered type of oscillations is obtained. Electron-ion viscosity instability is analyzed. Semicollisional drift-ballooning modes are considered with account of high pressure plasma effects. It is shown, that in case of low pressure plasma these modes are unstable. However, in tokamak with high pressure plasma such instability is absent. 24 refs.

44400 (IAE—4517/7) Optimization of experiment conditions of plasma probing by heavy ion beams. Zimeleva, L.G.; Krupnik, L.I.; Mel'nikov, A.V.; Samokhvalov, N.V. (Gosudarstvennyj Komitet po Ispol'zovaniyu Atomnoj Ehnergii SSSR, Moscow. Inst. Atomnoj Ehnergii). 1987. 33p. (In Russian). NTIS (US Sales Only), PC A03/MF A01. Order Number DE88703512/JAW.

Technique scheme of plasma probing by heavy ion beams and procedure for trajectory calculation and determination of configuration and sizes of the investigated region are presented. Problem statements of experiment conditions optimization of plasma probing by heavy particle beams are discussed. Examples of optimization problem solutions for different tokamak and stellarator conditions are presented. Values of probing beams main parameters are determined, different schemes of experiment with account of modern equipment potentialities are suggested. 23 refs.; 19 figs.; 2 tabs.

44401 (ITEF—90(1987)) Electron temperature measurement in Z-pinch. Gerusov, A.V.; Orlov, M.M.; Terent'ev, A.R.; Khrabrov, V.A. (Gosudarstvennyj Komitet po Ispol'zovaniyu Atomnoj Ehnergii SSSR, Moscow. Inst. Teoreticheskoj i Ehksperimental'noj Fiziki). 1987. 12p. (In Russian). NTIS (US Sales Only), PC A03/MF A01. Order Number DE88703596/JAW.

Measurement of temperature of emitting plasma sheath in noncylindrical Z-pinch in neon at the stage of convergence to the axis, based on comparing the intensity of spectral lines belonging to NeI, Ne2, is performed. Line intensity relation dependence was determined using calculations according to emitting-collision model. Spectra were recorded by electron-optical converter and relative intensity was determined by subsequent photometry of photolayer. Cylindric symmetrical MHD-calculations during which temperature and the observed line intensity relation were determined, are conducted. 9 refs.; 9 figs.

44402 (ITEF—164(1987)) Thermonuclear deflagration wave propagation due to fast charged products. Basko, M.M.; Bud'ko, A.B. (Gosudarstvennyj Komitet po Ispol'zovaniyu Atomnoj Ehnergii SSSR, Moscow. Inst. Teoreticheskoj i Ehksperimental'noj Fiziki). 1987. 20p. (In Russian). NTIS (US Sales Only), PC A03/MF A01. Order Number DE88703601/JAW.

Among thermonuclear reaction products fast charged particles exist which move practically along streight-line trajectories. During deceleration these fast particles heat thermonuclear fuel pellets, and as a result of this heating burn waves generate and propagate deflagration equations are written for this case. The energy and momentum transfer is treated in the framework of diffusion approximation. It is shown that, when one accounts for the microscopic momentum of the fast burn particles and ignores the macroscopic momentum of the fluid, the solution of the boundary-value problem for the stationary burn wave exists not for all parameter values. The diffusion equation employed to describe the energy transfer by fast burn particles is shown to reproduce adequately the kinetic restrictions on the burn propagation velocity. 8 refs.; 3 figs.

44403 (JAERI-M—87-206) Abel-inversion by Wiener filter. Yamashita, Yukihiko. (Japan Atomic Energy Research Inst., Tokyo). Jan 1988. 30p. (In Japanese). NTIS (US Sales Only), PC A03/MF A01. Order Number DE88753421/JAW.

In many cases, the intensity of light emitted from Tokamak plasmas has symmetry, so it possible to calculate the radial profiles of the intensity of light by Abel-inversion with several line-integral data. But the exisiting Abel-inversion method has many problems such as how to treat plasma elongation, shift of plasma center, spreaded view line and noise, calculation time and model. The new Abel-inversion method proposed in this paper can treat elongation, shift of center and spreaded view line simultaneously and minimize the mean square error with profile and noise. In this paper, we describe the equation and solution of this Abel-inversion by Wiener filter, and demonstrate the usefulness of the new Abel-inversion method by simulation and application.

44404 Impulse coupling to targets in vacuum by KrF, HF, and CO_2 single-pulse lasers. Phipps C.R. Jr.; Turner, T.P.; Harrison, R.F.; York, G.W.; Osborne, W.Z.; Anderson, G.K.; Corlis, X.F.; Haynes, L.C.; Steele, H.S.; Spicochi, K.C.; and others. (Los Alamos National Laboratory, Chemical and Laser Sciences Division, Mail Stop J566, Los Alamos, New Mexico 87545). *Journal of Applied Physics;* 64: No. 3, 1083-1096(1 Aug 1988).

We present a laser-target scaling model which permits approximate prediction of the dependence of ablation pressure, mechanical coupling coefficient, and related parameters in vacuum upon single-pulse laser intensity (I), wavelength (λ), and pulse width (tau) over extremely broad ranges. We show that existing data for vacuum mechanical coupling coefficient for metallic and endothermic nonmetallic, surface-absorbing planar targets follows this empirical trend to within a factor of 2 over 7 orders of magnitude in the product (Iλ(tau)/sup 1/2/). The comparison we present

is valid for intensity equal to or greater than the peak-coupling intensity I/sub max/, where dense

44405 **X-ray observations between 10 and 150 keV from the Alcator-C tokamak.** Rice, J.E.; Chamberlain, K.L. (Plasma Fusion Center, Massachusetts Institute of Technology, Cambridge, Massachusetts 02139). *Physical Review [Section] A: General Physics;* **38**: No. 3, 1461-1467(1 Aug 1988).

A mercuric iodide (HgI_3) detector has been used to obtain x-ray spectra in the energy range from 5 to 200 keV from the Alcator-C tokamak. During high-density Ohmic operation of Alcator-C, this detection system provides a reliable electron-temperature diagnostic. Nonthermal x-ray spectra above 20 keV are observed under certain conditions when a substantial amount of lower-hybrid rf (LHRF) power is injected. The magnitude of this nonthermal behavior strongly increases as the electron density is lowered and is more pronounced in deuterium plasmas than in hydrogen. Model electron distribution functions, which can give rise to the observed x-ray spectra, are discussed.

44406 **Magnetic tearing of plasma discharges due to nonuniform resistivity.** Hassam, A.B. (Laboratory for Plasma and Fusion Energy Studies, University of Maryland, College Park, Maryland 20742). *Physics of Fluids;* **31**: No. 8, 2068-2070(Aug 1988).

The rearrangement of current in a plasma discharge in response to resistivity nonuniformities within a magnetic surface is studied. It is shown that macroscopic magnetic islands develop about those surfaces where the nonuniformity is aligned with the magnetic field. If the nonuniformity and the field are not aligned anywhere, there is no current rearrangement; instead, relatively large plasma flows are set up. Such resistivity inhomogeneities can obtain in solar coronal loops and, in some circumstances, in tokamak discharges.

44407 **Mechanical injection of magnetic helicity.** Barnes, D.C. (Science Applications International Corporation, Austin, Texas 78746). *Physics of Fluids;* **31**: No. 8, 2214-2220(Aug 1988).

A novel technique for the injection of magnetic helicity into a closed volume is described. In this new approach, mechanical energy is converted directly into the production of magnetic helicity. Several geometries illustrate the flexibility of the approach. The application of mechanical injection of magnetic helicity to a magnetically insulated impact fusion system is briefly described. In this application, a $\beta >> 1$ spheromak plasma is produced by impact of electrically conducting shells. Magnetic helicity is injected by the relative motion of these shells and subsequent plasma relaxation produces the spheromak magnetic field.

44408 **Electrical circuit modeling of reversed field pinches.** Sprott, J.C. (Department of Physics, University of Wisconsin, Madison, Wisconsin 53706). *Physics of Fluids;* **31**: No. 8, 2266-2275(Aug 1988).

Equations are proposed to describe the radial variation of the magnetic field and current density in a circular, cylindrical reversed field pinch (RFP). These equations are used to derive the electrical circuit parameters (inductance, resistance, and coupling coefficient) for a RFP discharge. The circuit parameters are used to evaluate the flux and energy consumption for various start-up modes and for steady-state operation using oscillating field current drive. The results are applied to the MST device [Bull. Am. Phys. Soc. 32, 1830 (1987)].

44409 **Oscillating field current drive experiments in a reversed field pinch.** Schoenberg, K.F.; Ingraham, J.C.; Munson, C.P.; Weber, P.G.; Baker, D.A.; Gribble, R.F.; Howell, R.B.; Miller, G.; Reass, W.A.; Schofield, A.E.; and others. (Los Alamos National Laboratory, Los Alamos, New Mexico 87545). *Physics of Fluids;* **31**: No. 8, 2285-2291(Aug 1988).

Steady-state current sustainment by oscillating field current drive (OFCD) utilizes a technique in which the toroidal and poloidal magnetic fields at the plasma surface are modulated at audio frequencies in quadrature. Experiments on the ZT-40M reversed field pinch [Fusion Technol. 8, 1571 (1985)] have examined OFCD over a range of modulation amplitude, frequency, and phase. For all cases examined, the magnitude of the plasma current is dependent on the phase of the modulations as predicted by theory. However, evidence of current drive has only been observed at relatively low levels of injected power. For larger modulation amplitudes, the data suggest that substantial current drive is offset by increased plasma resistance as a result of modulation enhanced plasma—wall interactions. The initial experimental results and supporting theoretical interpretations of OFCD are discussed.

44410 **Slowing down tail enhanced, neoclassical and classical alpha particle fluxes in tokamak reactors.** Catto, P.J.; Tessarotto, M. (Science Applications International Corporation, Plasma Research Institute, 1515 Walnut Street, Boulder, Colorado 80302). *Physics of Fluids;* **31**: No. 8, 2292-2299(Aug 1988).

The classical and neoclassical particle and energy fluxes associated with a slowing down tail, alpha particle distribution function are evaluated for arbitrary aspect ratio ϵ^{-1}, cross section, and poloidal magnetic field. The retention of both electron and ion drag and pitch angle scattering by the background ions results in a large diffusive neoclassical heat flux in the plasma core. This flux remains substantial at larger radii only if the characteristic speed associated with pitch angle scattering, $\nu/\text{sub } b/$, is close enough to the alpha birth speed v_0 so that $\epsilon(v_0/v/\text{sub } b/)^3$ remains less than some order unity critical value which is not determined by the methods herein. The enhanced neoclassical losses would only have a serious impact on ignition if the critical value of $\epsilon(v_0/v/\text{sub } b/)^3$ is found to be somewhat larger than unity.

44411 **Plasma transport by relaxation of localized perturbations.** Hossain, M.; Hu, P.N.; Kress, M.; Blank, A.A.; Grad, H. (Courant Institute of Mathematical Sciences, New York University, 251 Mercer Street, New York, New York 10012). *Physics of Fluids;* **31**: No. 8, 2165-2170(Aug 1988).

Localized perturbations in temperature and density are introduced on a background (approximate) steady-state plasma. A simulation of the evolving plasma was carried out on a transport time scale. In all these simulations, the mass diffusion rate $\lambda/\text{sub } \xi/$ is significantly less than that, λ_1, based on resistivity alone. Braginskii transport has mainly been used and it has been found that $\lambda/\text{sub } \xi/ \sim 0.1\lambda_1$. Cases were also tested in which thermal conductivity is much larger than resistivity and it was found in the most extreme cases $\lambda/\text{sub } \xi/ = 0.5\lambda_1$. The results are explained in terms of the linearized diffusion eigenvalues and their (approximate) eigenmodes. The eigenvalues reflect the coupled effect of plasma diffusion and heat flow. Since this coupling is intrinsic to the magnetohydrodynamic system of equations itself, the coupling should generally be taken into consideration. In particular, it is concluded that theories neglecting coupling may inevitably interpret transport as "anomalous." These results are an initial step toward understanding the unresolved confinement issues for tokamaks including pellet induced increased particle confinement.

44412 **Electromagnetic radiation from strong Langmuir turbulence.** Akimoto, K.; Rowland, H.L.; Papadopoulos, K. (Earth and Space Science Division and Applied Theoretical Division, Los Alamos National Laboratory, Los Alamos, New Mexico 87545). *Physics of Fluids;* **31**: No. 8, 2185-2189(Aug 1988).

A series of computer simulations is reported showing the generation of electromagnetic radiation by strong Langmuir turbulence. The simulations were carried out with a fully electromagnetic 2 1/2 -dimensional fluid code. The radiation process takes place in two stages that reflect the evolution of the electrostatic turbulence. During the first stage while the electrostatic turbulence is evolving from an initial linear wave packet into a planar soliton, the radiation is primarily at $\omega/\text{sub } e/$. During the second stage when transverse instabilities lead to the collapse and dissipation of the solitons, $2\omega/\text{sub } e/$ and $\omega/\text{sub } e/$ radiation are comparable, and $3\omega/\text{sub } e/$ is also present. The radiation power at $\omega = 2\omega/\text{sub } e/$ is in good agreement with theoretical predictions for electromagnetic emissions by collapsing solitons.

44413 Runaway electron distributions and their stability with respect to the anomalous Doppler resonance. Fuchs, V.; Shoucri, M.; Teichmann, J.; Bers, A. (Tokamak de Varennes, Varennes, Quebec J0L 2P0, Canada). *Physics of Fluids;* **31**: No. 8, 2221-2227(Aug 1988).

The stability of nonrelativistic runaway electron distributions with respect to the anomalous Doppler resonance is examined in a range of parameters of interest to tokamaks, i.e., for Yequivalentω/sub p//sub e//Ω/sub c//sub e/≦2 and for Ohmic electric fields εequivalentE/E/sub c/≦0.1. Distribution functions are calculated numerically within a region up to 35v/sub e/ (thermal velocities) using a finite-element 2-D Fokker—Planck code. Alternatively, an analytic approximation for the runaway distribution function is used, valid beyond the critical velocity v/sub c/≃v/sub e/(E/sub c//E)^{1}/sup //^{2}. Stability thresholds in (ω,k/sub parallel/) space are then determined. For example, for Y = 1 and ε = 0.1, and providing that the runaway tail extends at least to 30v/sub e/, unstable waves exist having ω≦0.6Ω/sub c//sub e/ and k/sub parallel/≦0.03Ω/sub c//sub e//v/sub e/.

44414 Neoclassical quasilinear transport theory of fluctuations in toroidal plasmas. Shaing, K.C. (Oak Ridge National Laboratory, Oak Ridge, Tennessee 37831). *Physics of Fluids;* **31**: No. 8, 2249-2265(Aug 1988).

A transport theory of fluctuations with frequencies less than the gyrofrequency in toroidal plasmas is developed to calculate particle and heat fluxes, bootstrap current, Ware pinch flux, and modification to plasma conductivity. It is found that the particle and heat fluxes are proportional to summation/sub m//sub ,//sub n//sub ,//sub ω/m^{2}(ePhi-tilde/sub m//sub n//sub ω//T/sub e/)/sup =/, the bootstrap current and Ware pinch flux are proportional to summation/sub m//sub ,//sub n//sub ,//sub ω/m[(m-nq)/chemical bondm-nqchemical bond] (ePhi-tilde/sub m//sub n//sub ω//T/sub e/)^{2}, and the modification

44415 Magnetohydrodynamic clump instability. Tetreault, D.J. (Massachusetts Institute of Technology, Cambridge, Massachusetts 02139). *Physics of Fluids;* **31**: No. 8, 2122-2134(Aug 1988).

The theory of magnetohydrodynamic (MHD) clump instability in current driven plasma is presented. MHD clump fluctuations are current carrying bundles of correlated magnetic field lines. The instability occurs when turbulent mixing of the mean current density at island overlap produces clumps at a rate faster than their decay as a result of magnetic field line stochasticity. The renormalized dynamical equation describing MHD clump instability is derived from one-fluid MHD equations and conserves the dynamical invariants of the exact equations. The renormalized equation is a nonlinear, turbulent version of the Newcomb equation of linear MHD stability theory and can be cast into the form of a nonlinear MHD energy principle. MHD clump instability is a dynamical route to the Taylor state.

44416 Thomson scattering and plasma oscillations. Lippmann, B.A. (Lawrence Livermore National Laboratory, University of California, Livermore, California 94550). *American Journal of Physics;* **56**: No. 8, 725-726(Aug 1988).

A direct calculation shows that Thomson scattering: on the microscopic level: manifests itself as plasma oscillations: on the macroscopic level.

44417 Frequency up-conversion of electromagnetic radiation with use of an overdense plasma. Wilks, S.C.; Dawson, J.M.; Mori, W.B. (Department of Physics, University of California, Los Angeles, California). *Physical Review Letters;* **61**: No. 3, 337-340(18 Jul 1988).

We investigate the effects of quickly creating a plasma around a monochromatic electromagnetic source wave, on time scales on the order of a cycle of the wave. It is found that this results in an upshifting of the wave frequency, which can be varied by changing of the plasma density. It is also found that a substantial fraction of the B-field associated with the initial wave can be sustained in the plasma as a time-independent B field. Computer simulations have been used to study this process in detail, including the effects of finite ionization time. For long ionization times, strong plasma heating results.

44418 Real-time, vibration-compensated CO_2 interferometer operation on the DIII-D tokamak. Carlstrom, T.N.; Ahlgren, D.R.; Crosbie, J. (GA Technologies, P.O. Box 85608, San Diego, California 92138). *Review of Scientific Instruments;* **59**: No. 7, 1063-1066(Jul 1988).

A multichannel, two-color, quadrature heterodyne interferometer is used to measure the line density in the DIII-D tokamak. The unique feature of this real-time vibration-compensated interferometer is the combination of high speed (1 MHz), high resolution ($2\pi/256$), and wide range (+- 8193 fringes). Quadrature phase information from a CO_2 laser (10.6 μm) and a He—Ne laser (0.63 μm) are digitized with high-speed (6 MHz) flash digitizers. Zero crossings of the signals are counted with digital circuitry yielding quarter fringe resolution with a 4-MHz bandwidth. Further fringe resolution of 1/256 is provided at 350 kHz by a PROM which uses the digital signals as input to a look-up table. Analog line density is presently available at 80 kHz with a system noise equivalent phase shift of +- 2/256. Error monitoring is provided for low signal amplitude and exceeding the maximum fringe rate. In addition, a method to prevent coating of in-vessel mirrors due to plasma and vessel wall cleaning discharges has been developed.

44419 Pseudotomographic fitting algorithm for density profile reconstruction from a sparse 1-D interferometer array. Casey, J.A.; Sevillano, E.; Irby, J.H.; Lane, B.G. (Plasma Fusion Center, Massachusetts Institute of Technology, Cambridge, Massachusetts 02139). *Review of Scientific Instruments;* **59**: No. 7, 1067-1071(Jul 1988).

An algorithm has been developed for fast analysis of a sparse multichord interferometer array, yielding peak density, Gaussian width, radial offset, ellipticity, and instability amplitude and frequency from line-integrated density measurements. A nonlinear least-squares fit is performed over many short time intervals, with independent variables reduced to one dimension. Assumptions of plasma rigidity and slowly evolving rotation rate are necessary to trade temporal resolution (on instability timescales) for spatial resolution across the moving plasma column. Results from the Tara tandem mirror experiment are shown.

44420 Observation of H-mode confinement in the DIII-D tokamak with electron cyclotron heating. Lohr, J.; Stallard, B.W.; Prater, R.; Snider, R.T.; Burrell, K.H.; Groebner, R.J.; Hill, D.N.; Matsuda, K.; Moeller, C.P.; Petrie, T.W.; and others. (General Atomics, San Diego, California 92138). *Physical Review Letters;* **60**: No. 25, 2630-2633(20 Jun 1988).

The first observation of H-mode confinement with electron cyclotron heating as the sole auxiliary heating method has been made in divertor discharges in the DIII-D tokamak. These discharges exhibit the usual characteristics of the H mode, including improved confinement of particles and energy, when electron cyclotron heating is added at a power level above 0.7 MW. The H-mode transition is accompanied by the development of an electron temperature pedestal of 0.25 keV and a dramatic steepening of the density gradient near the separatrix.

44421 Physical mechanism of plasma currents induced by waves. Shaing, K.C. (Oak Ridge National Lab., TN (USA)). *Plasma Physics and Controlled Fusion;* **29**: No. 12, 1637-1641(Dec 1987). Contract AC05-84OR21400.

The physical mechanism of plasma currents induced by waves is discussed using plasma momentum and heat flux balance equations. Through the coupling of momentum and heat friction forces, both momentum and heat flux sources associated with waves can drive currents along the magnetic field. It is shown that the parallel current induced by the electron cyclotron waves is due to the absorption of the heat flux from the waves.

44422 Electron cyclotron heating using the fundamental extraordinary mode launched from the low field side on DIII-D. Prater, R.; Ejima, S.; Harvey, R.W.; Hsu, J.Y.; James, R.A.; Matsuda, K.; Lohr, J.; Mayberry, M.J.; Moeller, C.P.; Simonen, T.C.; and others. (GA Technologies Inc., San Diego, California 92138, U.S.A.). *AIP (American Institute of Physics) Conference Proceedings;* **159**: No. 1, 9-12(Sep 1987). (CONF-870570—).

From 7. topical conference on applications of radio-frequency power to plasmas; Kissimmee, FL, USA (4 May 1987).

Electron Cyclotron Heating experiments on the DIII-D tokamak using outside launch of the extraordinary mode have shown effective bulk heating at the fundamental resonance, in contradiction of the theory of wave propagation. This result may be explained by an efficient process of mode conversion from the extraordinary mode to the ordinary mode upon reflection at the vessel wall of waves reflected from the right hand cutoff in the plasma. The resulting heating has the characteristics expected for heating with the ordinary mode.

44423 **Polarization change of electron cyclotron waves by reflection.** Hsu, J.; Moeller, C.P. (GA Technologies Inc., San Diego, CA 92138). *AIP (American Institute of Physics) Conference Proceedings;* **159**: No. 1, 13-16(Sep 1987). (CONF-870570—).

From 7. topical conference on applications of radio-frequency power to plasmas; Kissimmee, FL, USA (4 May 1987).

Given that the wave numbers of X and O modes merge as they approach the plasma boundary, a pure mode reflected from the plasma by a cut off may excite both modes due to polarization change when it is reflected off the vacuum vessel wall since the tangential components of the electric field change sign. This may explain the good central heating in DIII-D ECH experiments in which the fundamental X-mode is launched from the low field side.

44424 **ECH in the microwave tokamak experiment.** Stallard, B.W.; Smith, G.R.; James, R.A.; Thomassen, K.I.; Kritz, A.H.; Makowski, M.; Samec, T.; Yamamoto, R. (Lawrence Livermore National Laboratory, University of California, Livermore, CA 94550). *AIP (American Institute of Physics) Conference Proceedings;* **159**: No. 1, 21-24(Sep 1987). (CONF-870570—).

From 7. topical conference on applications of radio-frequency power to plasmas; Kissimmee, FL, USA (4 May 1987).

The Microwave Tokamak Experiment (MTX) at LLNL will investigate electron heating in the MTX tokamak (formerly Alcator-C) at high density (up to 6 x 10^{20} m^{-3}) and high power by using a free electron laser (FEL). Parameters of the FEL are a peak power up to 8 GW and 50 ns duration, with average power 1 to 2 MW, at a frequency of 250 GHz. The planned input driver for the FEL is a gyrotron oscillator. The FEL output will be transported quasi-optically, inside a 50 cm evacuated pipe, to the input port of the tokamak by means of a four-mirror system. Launch polarization is the ordinary mode. This experiment will test the FEL technology at short wavelength and high peak and average power levels. Important physics issues to be explored are the effects of intense pulse heating (electric field up to 500 kV/cm) on nonlinear wave absorption and bulk heating, plasma confinement, plasma impurities, and parametric instabilities. Because the FEL technology is scalable to higher frequency and power, success of these experiments has importance for next-generation tokamaks.

44425 **Third-harmonic electron cyclotron heating for tokamak high-beta profile control studies.** Simonen, T.C.; Matsuda, K.; Prater, R.; Smith, G.R. (GA Technologies Inc., San Diego, CA 92138). *AIP (American Institute of Physics) Conference Proceedings;* **159**: No. 1, 45-48(Sep 1987). (CONF-870570—).

From 7. topical conference on applications of radio-frequency power to plasmas; Kissimmee, FL, USA (4 May 1987).

Third-harmonic extraordinary-mode ECH could be employed for D III-D high-beta studies at reduced toroidal magnetic field. D III-D neutral beam injection increases the electron temperature above 4 keV. At 4 x 10^{19} m^{-3} density, the third-harmonic 120 GHz ECH power should be absorbed with greater than 80% efficiency. Absorption would increase at higher temperature unless the distribution function is too severely distorted by the high-power ECH. A 6 MW-120 GHz system could thereby allow well-controlled beta and profile control studies using third-harmonic ECH.

44426 **Electron cyclotron heating in the compact ignition tokamak.** Mazzucato, E.; Fidone, I.; Meyer, R.L. (Princeton University, Plasma Physics Laboratory, Princeton, N.J. 08544). *AIP (American Institute of Physics) Conference Proceedings;* **159**: No. 1, 57-60(Sep 1987). (CONF-870570—).

From 7. topical conference on applications of radio-frequency power to plasmas; Kissimmee, FL, USA (4 May 1987).

A new form of the dispersion relation of electron cyclotron waves in hot plasmas is used for the study of auxiliary heating in the Compact Ignition Tokamak (CIT). It is shown that the extraordinary mode with a frequency of 190 GHz can be used in CIT plasmas with a central electron density of 1 x 10^{-15} cm^{-3} and a toroidal magnetic field of 105 kG.

44427 **Ray-tracing study of electron-cyclotron heating and current drive in D III-D.** Kritz, A.H.; Smith, G.R.; Nevins, W.M. (Hunter College/CUNY, New York, NY 10021). *AIP (American Institute of Physics) Conference Proceedings;* **159**: No. 1, 61-64(Sep 1987). (CONF-870570—).

From 7. topical conference on applications of radio-frequency power to plasmas; Kissimmee, FL, USA (4 May 1987).

Ongoing and planned experiments in D III-D utilize X-mode power for heating and current drive. For X-mode power launched from the low-field side, the magnetic field is reduced so that the power is deposited at the second-harmonic resonance near the center of the plasma. It is found that when the entral density is n = 1.8 x 10 cm^{-3} and the eight available antennae are used to launch the power, the power deposition is not localized. X-mode power launched from the high-field side, the increase in ECH driven current with decreasing density and increasing toroidal angle is illustrated. For the plasma parameters considered here it is found that current-drive efficiencies of the order of 0.8 Amps/Watt can be achieved in D III-D.

44428 **Second harmonic electron cyclotron heating calculations for the ATF torsatron.** Goldfinger, R.C.; Batchelor, D.B. (Oak Ridge National Laboratory, Oak Ridge, Tennessee 37831). *AIP (American Institute of Physics) Conference Proceedings;* **159**: No. 1, 65-68(Sep 1987). (CONF-870570—).

From 7. topical conference on applications of radio-frequency power to plasmas; Kissimmee, FL, USA (4 May 1987).

The heating of the Advanced Toroidal Facility now under construction at Oak Ridge National Laboratory has been investigated using ray tracing techniques. The effect of electron cyclotron waves at the second harmonic resonance is studied using the RAYS geometrical optics code assuming anticipated steady state parameters. A comparison is made of the heating efficiency using two launching schemes: a linearly polarized antenna providing a narrow beam and a TE_{02} waveguide. The first pass ray tracing calculations are incorporated in a wall reflection/power balance model which includes the effects of wall reflected rays and wall losses. It is shown that the power absorbed in the plasma after multiple reflections is preferentially absorbed near the center of the plasma. A significant fraction of the incident power is predicted to ultimately be deposited in the plasma, rather than lost to walls and ports.

44429 **Three-dimensional model of electron cyclotron heating.** McCoy, M.G.; Kerbel, G.D.; Harvey, R.W. (National Magnetic Fusion Energy Computer Center, Lawrence Livermore National Laboratory, Livermore, CA 94550). *AIP (American Institute of Physics) Conference Proceedings;* **159**: No. 1, 77-80(Sep 1987). (CONF-870570—).

From 7. topical conference on applications of radio-frequency power to plasmas; Kissimmee, FL, USA (4 May 1987).

To address heating problems in tokamaks, we have implemented a 3-D Fokker-Planck/rf code. This code uses a 2-D bounce-averaged Fokker-Planck package to solve for the distribution on a radial mesh. The rf energy density ξ/sub k/ is determined as a solution to a transport equation involving the local power absorption and the group velocity of the wave. Once ξ/sub k/ is determined it is used to update the quasi-linear diffusion coefficients and resume the Fokker-Planck calculation. A fast procedure for simulating a tokamak diagnostic, the soft-x-ray analyzer, is presented.

44430 **Applications of computer models in the study of lower hybrid RF plasma heating and current drive.** Bonoli, P.T. (Plasma Fusion Center, M.I.T., Cambridge, MA 02139). *AIP (American Institute of Physics) Conference Proceedings;* **159**: No. 1, 85-93(Sep 1987). (CONF-870570—).

From 7. topical conference on applications of radio-frequency power to plasmas; Kissimmee, FL, USA (4 May 1987).

In recent years lower hybrid (LH) waves have been successfully utilized for electron and ion plasma heating, to sustain toroidal plasma current, and to stabilize sawteeth in tokamaks. In order to understand the underlying physics of these experiments, make detailed comparisons between theory and experiment, and to extrapolate these results to the reactor regime, a considerable efforts has been devoted to the development of simulation models for lower hybrid current drive (LHCD) and lower hybrid heating (LHH). Such models incorporate a 1-D radial transport code, Fokker-Planck code, and a toroidal ray tracing calculation. Physics issues critical to the understanding of LHRF experiments can then be studied such as the "spectral-gap" problem associated with LH wave propagation and absorption, the confinement and spatial diffusion of suprathermal tail electrons, and the apparent discrepancy between theoretical and experimental values of the current drive figure of merit. The objective of this paper is to review the basic structure of these computer models, pointing out the assumptions and major uncertainties in each model component. Comparisons between model predictions and experiment will be given for the PLT and Alcataor C LHRF experiments.

44431 **Current drive verus the launched N/sub parallel/ spectrum.** Stevens, J.; Bell, R.; Bernabei, S.; Cavallo, A.; Chu, T.K.; Motley, R.W.; VonGoeler, S. (Princeton Plasma Physics Laboratory). *AIP (American Institute of Physics) Conference Proceedings;* **159**: No. 1, 143-146(Sep 1987). (CONF-870570—).

From 7. topical conference on applications of radio-frequency power to plasmas; Kissimmee, FL, USA (4 May 1987).

Lower hybrid experiments on PLT with a narrow wavenumber spectrum have shown a 40% improvement in the current drive figure of merit eta/sub C//sub D/ over previous PLT results. The simple assumption that the electron tail energy is determined by the launched n/sub parallel/ spectrum gives a good qualitative description of all of the PLT current drive results.

44432 **Current-drive, anti-current drive, and balanced injection.** von Goeler, S.; Stevens, J.; Beiersdorfer, P.; Bell, R.; Bernabei, S.; Bitter, M.; Cavallo, A.; Chu, T.K.; Fishman, H.; Hill, K.; and others. (Princeton University). *AIP (American Institute of Physics) Conference Proceedings;* **159**: No. 1, 163-166(Sep 1987). (CONF-870570—).

From 7. topical conference on applications of radio-frequency power to plasmas; Kissimmee, FL, USA (4 May 1987).

The severe limitations in ordinary lower hybrid current drive discharge in regard to the superthermal electrons as well as the kinetic energy stored in the energetic tail can be overcome in bidirectional scenarios like anticurrent drive, balanced injection, or strong current ramp up. (AIP)

44433 **Study of mode-converted and directly-excited ion Bernstein waves by CO_2 laser scattering in Alcator C.** Takase, Y.; Fiore, C.L.; McDermott, F.S.; Moody, J.D.; Porkolab, M.; Shepard, T.; Squire, J. (Plasma Fusion Center, Massachusetts Institute of Technology, Cambridge, MA 02139). *AIP (American Institute of Physics) Conference Proceedings;* **159**: No. 1, 266-269(Sep 1987). (CONF-870570—).

From 7. topical conference on applications of radio-frequency power to plasmas; Kissimmee, FL, USA (4 May 1987).

Mode-converted and directly excited ion Bernstein waves (IBW) were studied using CO_2 laser scattering in the Alcator C tokamak. During the ICRF fast wave heating experiments, mode-converted IBW was observed on the high-field side of the resonance in both second harmonic and minority heating regimes. By comparing the relative scattered powers from the two antennas separated by 180° toroidally, an increased toroidal wave damping with increasing density was inferred. In the IBW heating experiments, optimum direct excitation is obtained when an ion-cyclotron harmonic layer is located just behind the antenna. Wave absorption at the $\omega = 3\Omega$/sub D/ $= 1.5\Omega$/sub H/ layer was directly observed. Edge ion heating was inferred from the IBW dispersion when this absorption layer was located in the plasma periphery, which may be responsible for the observed improvement in particle confinement.

44434 **Visible spectroscopy on RF heated discharges in the Princeton large Torus tokamak.** McNeill, D.H.; Lehrman, I.S.; Greene, G.J.; Ono, M.; Vojtsenya, V.S.; Wilson, J.R. (Plasma Physics Laboratory, Princeton University, Princeton, NJ 08544). *AIP (American Institute of Physics) Conference Proceedings;* **159**: No. 1, 270-273(Sep 1987). (CONF-870570—).

From 7. topical conference on applications of radio-frequency power to plasmas; Kissimmee, FL, USA (4 May 1987).

The lineshape and intensity of the H alpha line are used in calculations of the radial dependences of the neutral particle densities, H alpha emissivity, and electron production rate which are then related to particle confinement in the discharge. Stark shift of Balmer series lines is proposed for detecting rectified RF fields near ICRH antennas, provided the electron temperature varies little as the RF power is raised. The intensity ratio of Cr I lines at a Bernstein wave antenna was found to vary by less than 30% as the power was raised to 100 kW.

44435 **Boundary effects on minority ion resonance heating.** Tataronis, J.A.; Wang, J. (University of Wisconsin, Madison, WI 53706). *AIP (American Institute of Physics) Conference Proceedings;* **159**: No. 1, 338-341(Sep 1987). (CONF-870570—).

From 7. topical conference on applications of radio-frequency power to plasmas; Kissimmee, FL, USA (4 May 1987).

Minority ion resonance heating in a bounded plasma column with weak spatial inhomogeneities along the plasma axis is explored. This geometrical configuration simulates plasma confined in a mirror device. In the presence of boundaries, plasmas may support waves that have no counterparts in unbounded geometry. It it this class of rf modes that we examine for possible coupling to minority ions through the cyclotron resonance. As our basic plasma configuration, we examine a cold, uniform, magnetized, plasma cylinder, separated radially from a vacuum region by a free interface. The plasma is composed of electrons, a dominant ion species, and one or more species of heavier, low density (minority) ions. The rf wave dispersion characteristics and coupling to the heavy minority ions in this sharp boundary model are explored. To simulate a magnetic beach, which is a characteristic of a mirror magnetic field, weak axial inhomogeneities are introduced, and the implications are examined.

44436 **Modeling of ICRH experiments in the Tara tandem mirror.** Myer, R.C.; Golovato, S.N. (Plasma Fusion Center, M.I.T., Cambridge, MA 02139). *AIP (American Institute of Physics) Conference Proceedings;* **159**: No. 1, 374-377(Sep 1987). (CONF-870570—).

From 7. topical conference on applications of radio-frequency power to plasmas; Kissimmee, FL, USA (4 May 1987).

The production and heating of the central cell plasma in Tara is provided by a slot antenna located on the midplane bump of the axial magnetic field profile. Slow ion cyclotron waves excited by the slot propagate down a magnetic beach to ion cyclotron resonance layers located on either side of the bump where the RF power is strongly damped by the ions. Two different theoretical models are being used to study the efficiency of coupling to slow waves in this configuration. Wave propagation models which are based on the infinite plasma dispersion relation for a cold plasma indicate that radially propagating left hand polarized slow waves are converted to right hand polarized fast waves at the Alfven resonance layer due to the radial density gradient. If this were to occur we would expect a lower coupling efficiency to the ions in the plasma core. On the other hand, a nonlocal kinetic model of RF wave propagation in a nonuniform plasma slab indicates that significant left hand component of the electric field extends beyond the Alfven resonance layer. Preliminary experimental measurements of the radial inductive field profile agree qualitatively with the predictions of the cold plasma model, however, there is insufficient data at this time time to establish that a density limit for slow wave accessibility to the plasma core exists.

44437 **ICRF current drive for INTOR/ETR.** Ehst, D.A.; Mau, T.K. (Argonne National Laboratory, Argonne, IL 60439). *AIP (American Institute of Physics) Conference Proceedings;* **159**: No. 1, 386-389(Sep 1987). (CONF-870570—).

From 7. topical conference on applications of radio-frequency power to plasmas; Kissimmee, FL, USA (4 May 1987).

Initial studies of ICRF current drive in which electron Landau and transit time magnetic damping are used to create centrally peaked current profiles in two-dimensional MHD equilibrium. (AIP)

44438 **Global ICRH modeling in large noncircular tokamak plasmas with finite temperature.** Jaeger, E.F.; Batchelor, D.B.; Weitzner, H.; Colestock, P.L. (Oak Ridge National Laboratory, Oak Ridge, TN 37831). *AIP (American Institute of Physics) Conference Proceedings;* **159**: No. 1, 394-397(Sep 1987). (CONF-870570—).

From 7. topical conference on applications of radio-frequency power to plasmas; Kissimmee, FL, USA (4 May 1987).

Full-wave ion-cyclotron resonance heating (ICRH) coupling calculations in two and three dimensions have been extended to treat tokamaks with noncircular flux surfaces and conducting boundaries. The magnetic field configuration is derived from a Solov'ev equilibrium with finite poloidal magnetic fields. The conducting boundary may be of arbitrary shape. The mode conversion model is that of Colestock et al. in which the fourth-order finite-temperature wave equation is reduced to a second-order equation that describes the effects of mode conversion on the fast wave but neglects the detailed structure of the ion Bernstein wave. Results show the effect of a noncircular cross section on excitation, wave propagation, and absorption in Doublet III-D and the Joint European Torus (JET). Also, in the limit of a circular cross section, toroidal phasing of the resonant double-loop antenna design for the Tokamak Fusion Test Reactor (TFTR) is studied.

44439 **Dense, low-temperature, plasma target driven by an immersed, inductive antenna.** Trow, J.R.; Moses, K.G. (JAYCOR, Plasma Technology Division, Torrance, CA 90503). *AIP (American Institute of Physics) Conference Proceedings;* **159**: No. 1, 464-467(Sep 1987). (CONF-870570—).

From 7. topical conference on applications of radio-frequency power to plasmas; Kissimmee, FL, USA (4 May 1987).

A rectangular plasma target (35 x 15 x 40 cm) with electron densities near 2 x 10^{13} cm^{-3} for hydrogen, near 6 x 10^{13} cm^{-3} for argon, and near 10^{14} cm^{-3} for xenon, has been produced by an rf inductive discharge. This plasma target is being developed as a neutralizer for a negative-hydrogen-ion-based neutral-beam heating system for magnetically confined fusion plasma. The results of operation with a 3-turn antenna at 1.4 MHz and up to 60 kW pulsed rf power are reported here.

44440 **Alfven wave probe studies on PRETEXT.** Oakes, M.E.; Booth, W.D. (Department of Physics and Fusion Research Center, The University of Texas at Austin, Austin, Texas 78712). *AIP (American Institute of Physics) Conference Proceedings;* **159**: No. 1, 410-413(Sep 1987). (CONF-870570—).

From 7. topical conference on applications of radio-frequency power to plasmas; Kissimmee, FL, USA (4 May 1987).

Alfven waves launched with two toroidal antennas have been studied in the PRETEXT tokamak. Impedance measurements and laser interferometry have been used to investigate the structure of global modes. The radial profiles measured with the laser were limited to radial positions with adequate density. In order to complement these results we have inserted magnetic probes to measure the wave field in the plasma. The probes can safely scan from the limiter to 5 cm inside the plasma. The results are compared with a cylindrical kinetic code.

44441 **Heating and stabilization by slow waves in the Tara tandem mirror.** Golovato, S.N.; Brau, K.; Casey, J.; Coleman, J.; Gerver, M.; Guss, W.; Hallock, G.; Horne, S.; Irby, J.; Kesner, J.; and others. (Plasma Fusion Center, M.I.T., Cambridge, MA 02139). *AIP (American Institute of Physics) Conference Proceedings;* **159**: No. 1, 254-257(Sep 1987). (CONF-870570—).

From 7. topical conference on applications of radio-frequency power to plasmas; Kissimmee, FL, USA (4 May 1987).

The Tara tandem mirror is typically run in an effectively axisymmetric configuration by not producing β in the quadrupole anchor cells. Slow ion cyclotron wave excitation by a slot antenna located on a midplane bump in the magnetic field of the central cell provides plasma production and heating. Ion cyclotron resonances are at the minimum central cell fields on either side of the bump. Magnetic probe measurements have identified the slow wave excited by the antenna. Effective ion and electron heating is observed with a peak β of over 2%. The ICRF also provides stabilization of an m = 1 flute mode which is otherwise unstable in axisymmetric mirror geometry. In conjunction with a magnetic divertor at the central cell midplane, the slow wave can stabilize not only the central cell plasma but additional plasma in the axisymmetric plug cells. Destabilizing β can be produced in the plug cells by neutral beam injection, ICRF, or ECRH. By maintaining the stability of the plugs and central cell, end plugging using either ICRF or ECRH in the plug cells is obtained.

44442 **Role of ICRF-induced ponderomotive force on the tokamak edge plasma.** Myra, J.R.; D'Ippolito, D.A.; Francis, G.L. (Science Applications International Corporation, Plasma Research Institute, 1515 Walnut St., Boulder, CO 80302). *AIP (American Institute of Physics) Conference Proceedings;* **159**: No. 1, 334-337(Sep 1987). (CONF-870570—).

From 7. topical conference on applications of radio-frequency power to plasmas; Kissimmee, FL, USA (4 May 1987).

The ponderomotive force due to applied ICRF waves can influence MHD equilibrium and stability. Conditions on chemical bondEchemical bond^2 for stabilization of kink and ballooning modes are summarized. The ponderomotive force is found to be particularly important in the edge plasma when strongly evanescent surface waves with a significant E/sub parallel/ component are produced (e.g. by ion Bernstein wave couplers). The solution of a simple model for the ICRF field penetration indicates that a stabilizing ponderomotive force layer about 1 cm in thickness is achievable for an edge density of 2 x 10^{12} cm^{-3} and a parallel electric field of about 250 V/cm. Order-of-magnitude estimates of the corresponding ICRF power are discussed.

44443 **Effect of parallel electric fields on the ponderomotive stabilization of MHD instabilities.** Litwin, C.; Hershkowitz, N. (University of Wisconsin, Madison, Wi. 63706). *AIP (American Institute of Physics) Conference Proceedings;* **159**: No. 1, 426-429(Sep 1987). (CONF-870570—).

From 7. topical conference on applications of radio-frequency power to plasmas; Kissimmee, FL, USA (4 May 1987).

The contribution of the wave electric field component E/sub parallel/, parallel to the magnetic field, to the ponderomotive stabilization of curvature driven instabilities is evaluated and compared to the transverse component contribution. For the experimental density range, in which the stability is primarily determined by the m = 1 magnetosonic wave, this contribution is found to be the dominant and stabilizing when the electron temperature is neglected. For sufficiently high electron temperatures the dominant fast wave is found to be axially evanescent. In the same limit, E/sub parallel/ becomes radially oscillating. It is concluded that the increased electron temperature near the plasma surface reduces the magnitude of ponderomotive effects.

44444 **Finite Larmor radius effects on plasma absorption of electron cyclotron waves.** Mazzucato, E.; Fidone, I.; Granata, G. (Princeton University, Plasma Physics Laboratory, Princeton, N.J. 08544). *AIP (American Institute of Physics) Conference Proceedings;* **159**: No. 1, 53-56(Sep 1987). (CONF-870570—).

From 7. topical conference on applications of radio-frequency power to plasmas; Kissimmee, FL, USA (4 May 1987).

Finite Larmor radius effects on the plasma absorption of electromagnetic waves with oblique propagation and frequency below the electron cyclotron frequency are investigated. It is shown that the strong reduction of the damping of the extraordinary mode, caused by high order Larmor radius terms for perpendicular propagation and large values of (ω/sub p//ω/sub c/)^2, diminishes significantly at large values of N/sub parallel/.

44445 Localized electron-cyclotron heating and current drive in the TIBER-II reactor study. Smith, G.R.; Logan, B.G.; Kritz, A.H. (Lawrence Livermore National Laboratory, University of California, Livermire, CA 94550). *AIP (American Institute of Physics) Conference Proceedings;* **159**: No. 1, 69-72(Sep 1987). (CONF-870570—).

From 7. topical conference on applications of radio-frequency power to plasmas; Kissimmee, FL, USA (4 May 1987).

A scenario is shown for launching 10 MW of 450 GHz extraordinary-mode electron-cyclotron waves into a TIBER-II equilibrium. Localized, high-efficiency current drive near but outside the q = 2 surface causes substantial reduction in the current gradients that may play a role in major disruptions and anomalous transport. The same launch geometry shows promise for heating the plasma core during startup.

44446 Energy propagation and field structure of LH fast waves in the UCLA continuous current tokamak (CCT). Lai, K.F.; Mau, T.K.; Fried, B.D.; Taylor, R.J. (University of California, Los Angeles, CA 90024). *AIP (American Institute of Physics) Conference Proceedings;* **159**: No. 1, 111-114(Sep 1987). (CONF-870570—).

From 7. topical conference on applications of radio-frequency power to plasmas; Kissimmee, FL, USA (4 May 1987).

3D field maps of the lower hybrid fast waves have been measured in the UCLA CCT tokamak in both the current drive and test wave experiments. The waves was found to propagate at a relatively constant small angle (<20°) to the magnetic field lines. When launched from the edge, the plasma filters the antenna spectrum allowing only the component N/sub ///sub //≅N/sub perpendicular/ to penetrate. The wave damping cannot be accounted for either by Landau or collisional damping. The measured N/sub perpendicular//N/sub ///sub //≅1 suggests mode scattering between the fast and slow modes. The low N/sub ///sub // component however can be excited when launch directly at the center of the plasma using a small dipole antenna. Substantial asymmetry of the propagated wave pattern was observed in both the up-down and in-out directions.

44447 Study of m = 2 activity during lower-hybrid-driven, low q discharges in PLT. Motley, R.W.; Bell, R.; Bernabei, S.; Cavallo, A.; Chu, T.K.; Soeldner, F.; Stevens, J.; von Goeler, S. (Princeton Plasma Physics Laboratory, Princeton University, P.O. Box 451, Princeton, NJ 08544). *AIP (American Institute of Physics) Conference Proceedings;* **159**: No. 1, 147-150(Sep 1987). (CONF-870570—).

From 7. topical conference on applications of radio-frequency power to plasmas; Kissimmee, FL, USA (4 May 1987).

Lower hybrid driven discharges in PLT with q<2.5 are unstable to m = 2 instabilities, as observed on Mirnov loops. The mode structure grows within a few milliseconds to encompass most of the plasma column. After the mode slows down from a few kilohertz and locks in, a mini disruption occurs, giving rise to a drop in the population of the high energy electron tail, a rise in the impurity level, and a loss of 30—50% of the plasma energy.

44448 Modeling of vertical ECE during lower hybrid current drive on PLT. Luce, T.C.; Efthimion, P.C.; Fisch, N.J.; Bell, R.E.; Stevens, J.E. (Princeton University, Princeton, NJ 08544). *AIP (American Institute of Physics) Conference Proceedings;* **159**: No. 1, 167-170(Sep 1987). (CONF-870570—).

From 7. topical conference on applications of radio-frequency power to plasmas; Kissimmee, FL, USA (4 May 1987).

Electron cyclotron emission of both polarizations has been measured on the PLT tokamak during 2.45 GHz lower hybrid current drive. The experimental configuration allows identification of radiation at any frequency with the kinetic energy of the emitting electron. Fitting functions and a theoretical model have been used in an attempt to reproduce the measured spectra.

44449 Fast wave dispersion, damping, and electron current drive in the Irvine torus. Platt, R.C.; McWilliams, R. (University of California, Irvine, CA 92717). *AIP (American Institute of Physics) Conference Proceedings;* **159**: No. 1, 171-174(Sep 1987). (CONF-870570—).

From 7. topical conference on applications of radio-frequency power to plasmas; Kissimmee, FL, USA (4 May 1987).

Fast waves with frequencies near the mean gyrofrequency were excited in a toroidal magnetized plasma. Experimental measurements of wave dispersion were found to be in good agreement with predictions from cold plasma theory. Experimental measurements of wave damping lengths have been made. Measured damping lengths were found to be anomalously short when compared to predictions for electron Landau-damping, transit-time magnetic pumping and collisional damping. Unidirectional fast waves drove steady-state electron currents. Peak efficiencies up to eta = InR/P = 6 x 10^{-2} A/W(10^{13} cm^{-3})m were observed with up to 14% of the wave energy converted to poloidal magnetic field energy.

44450 Particle transport simulation of lower-hybrid current drive experiments on the Versator II tokamak. Chen, K.h.; Luckhardt, S.C.; Mayberry, M.J.; Porkolab, M. (Plasma Fusion Center and Research Laboratory of Electronics, Massachusetts Institute of Technology, Cambridge, Massachusetts 02139). *AIP (American Institute of Physics) Conference Proceedings;* **159**: No. 1, 183-186(Sep 1987). (CONF-870570—).

From 7. topical conference on applications of radio-frequency power to plasmas; Kissimmee, FL, USA (4 May 1987).

The one-dimensional particle transport equation has been solved numerically to simulate temporal and spatial evolutions of density behavior observed during 800MHz and 2.45GHz LHCD experiments. In order to fit the 800MHz profiles, the inward pinch velocity has to be increased several fold. However, for the 2.45GHz case, the reduction of the diffusive loss near the periphery seems to be needed.

44451 Three wave mode conversion in the lower hybrid frequency range. Cho, S.; Swanson, D.G. (Auburn University, AL 36849). *AIP (American Institute of Physics) Conference Proceedings;* **159**: No. 1, 191-194(Sep 1987). (CONF-870570—).

From 7. topical conference on applications of radio-frequency power to plasmas; Kissimmee, FL, USA (4 May 1987).

It has been shown that propagation of lower hybrid rays sometimes involves cases where three types of waves are coupled through linear mode conversion in the same region of space, namely the cold lower hybrid wave, the warm lower hybrid wave, and an ion Bernstein mode. This three wave mode conversion problem is analyzed in terms of a sixth order differential equation which describes coupling between all branches, and analytic coupling coefficients are found for the case without the local absorption term. The formal solution of this equation shows that a non-trivial amount of the incident cold wave energy goes into an ion Bernstein mode, which is then absorbed by electrons via Landau damping, rather than converting into the warm branch totally, when they are closely coupled in space.

44452 Fast wave ICRF minority heating experiments on the Alcator C tokamak. Shepard, T.D.; Fiore, C.L.; McDermott, F.S.; Parker, R.R.; Porkolab, M. (Plasma Fusion Center, M.I.T. Cambridge, MA 02139). *AIP (American Institute of Physics) Conference Proceedings;* **159**: No. 1, 262-265(Sep 1987). (CONF-870570—).

From 7. topical conference on applications of radio-frequency power to plasmas; Kissimmee, FL, USA (4 May 1987).

Ion cyclotron heating experiments using the fast magnetosonic wave were carried out in the Alcator C tokamak. Significant ion heating was observed as RF power up to 450 kW at 180 MHz for pulse lengths up to 200 ms was injected into Alcator C discharges with toroidal field B/sub T/ = 12 T. The majority ion species was deuterium and the minority was hydrogen. The density was scanned from n-bar/sub e/ = 0.5—5.5 x 10^{14} cm^{-3} and the minority concentration was scanned from 0.5—8%. The largest deuterium temperature increase observed was ΔT/sub D/ = 412 eV, which occurred at n-bar/sub e/ = 1.4 x 10^{14} cm^{-3}, P/sub r//sub f/ = 300 kW, and Δt/sub r//sub f/ = 175 ms. While both the central ion temperature increment and the net injected RF power decreased with density, the heating parameter n/sub e/ΔT/sub D//P/sub r//sub f/ remained nearly independent of density. Experiments were conducted using two different antennas. One antenna

launched power only from the low-field side of the plasma, while the other launched power from both low and high-field sides. No significant difference was observed in the heating efficiencies of the two antennas.

44453 **Two-dimensional effects in the absorption and mode conversion of fast magnetosonic waves in tokamaks.** Phillips, C.K.; Colestock, P.L.; Swanson, D.G. (Plasma Physics Laboratory, Princeton University, Princeton, NJ 08544). *AIP (American Institute of Physics) Conference Proceedings;* **159**: No. 1, 346-349(Sep 1987). (CONF-870570—).

From 7. topical conference on applications of radio-frequency power to plasmas; Kissimmee, FL, USA (4 May 1987).

Two-dimensional refractive effects on the absorption and mode conversion of fast waves in tokamaks have been included in the wave equation using a simplified two-dimensional model for the kinetic absorption and mode conversion layer in tokamaks. The equilibrium magnetic field is assumed to be oriented in the z-direction and to vary linearly in the x-direction, while the equilibrium density is allowed to vary in the y-direction. Using the parabolic approximation, the mode conversion-tunneling equation has been derived from the linearized Vlasov-Maxwell system of the equations. In addition, the corresponding two-dimensional form of the power conservation equation will be discussed.

44454 **Plasma heating near ion cyclotron resonance harmonic layer.** Imre, K.; Weitzner, H. (Courant Institute of Mathematical Sciences, NYU, New York, N.Y. 10012). *AIP (American Institute of Physics) Conference Proceedings;* **159**: No. 1, 354-357(Sep 1987). (CONF-870570—).

From 7. topical conference on applications of radio-frequency power to plasmas; Kissimmee, FL, USA (4 May 1987).

A survey of results is presented for plasma heating and wave propagations for incident waves with frequencies matching ion cyclotron resonance harmonics. It is assumed that outside the resonance layer geometrical optics is applicable, and the plasma is stratified perpendicularly to the equilibrium magnetic field. A boundary layer expansion is used near the resonance layer. Numerical results for the case of pure third and fundamental resonances are given. Ion-ion hybrid resonance case with the minority species at fundamental resonance is also presented.

44455 **Wave propagation at ion cyclotron resonance in large toroids.** Weitzner, H.; Imre, K.; Batchelor, D.B. (Courant Institute of Mathematical Sciences, NYU, New York, N.Y. 10012). *AIP (American Institute of Physics) Conference Proceedings;* **159**: No. 1, 358-361(Sep 1987). (CONF-870570—).

From 7. topical conference on applications of radio-frequency power to plasmas; Kissimmee, FL, USA (4 May 1987).

The range of validity of the perpendicularly stratified approximation near cyclotron harmonic resonance layers is examined for large toroids. Where the usual approximation fails integro-differential equations apply. Some exact results are given.

44456 **Fast-wave transmission and reflection in ion-cyclotron heating.** Fuchs; Lashmore-Davies, C.N.; Francis, G.; Ram, A.K.; Bers, A. (MIT, Plasma Fusion Center, Cambridge, MA 02139). *AIP (American Institute of Physics) Conference Proceedings;* **159**: No. 1, 366-369(Sep 1987). (CONF-870570—).

From 7. topical conference on applications of radio-frequency power to plasmas; Kissimmee, FL, USA (4 May 1987).

A second-order differential equation for the ion-cyclotron fast wave propagating in a hot, two ion species plasma is obtained. The equation includes the effects of both minority fundamental and majority second harmonic cyclotron damping. The approximation is based upon replacing the coupling to the ion Bernstein wave by a modified propagation description of the fast wave. For the case of perpendicular propagation, the second order equation reduces to the Budden equation giving the well known transmission coefficient for both two ion hybrid and second harmonic resonance. The solutions of the second order equation as a function of n/sub parallel/ give transmission and reflection coefficients which agree very well with the results based on models using higher order differential equations.

44457 **Ion cyclotron emission calculations using a 2D full wave numerical code.** Batchelor, D.B.; Jaeger, E.F.; Colestock, P.L. (Oak Ridge National Laboratory, Oak Ridge, TN 37831). *AIP (American Institute of Physics) Conference Proceedings;* **159**: No. 1, 390-393(Sep 1987). (CONF-870570—).

From 7. topical conference on applications of radio-frequency power to plasmas; Kissimmee, FL, USA (4 May 1987).

Measurement of radiation in the HF band due to cyclotron emission by energetic ions produced by fusion reactions or neutral beam injection promises to be a useful diagnostic on large devices which are entering the reactor regime of operation. A number of complications make the modelling and interpretation of such measurements difficult using conventional geometrical optics methods. In particular the long wavelength and lack of high directivity of antennas in this frequency regime make observation of a single path across the plasma into a viewing dump impractical. Pickup antennas effectively see the whole plasma and wall reflection effects are important. We have modified our 2D full wave ICRH code[a] to calculate wave fields due to a distribution of energetic ions in tokamak geometry. The radiation is modeled as due to an ensemble of localized source currents distributed in space. The spatial structure of the coherent wave field is then calculated including cyclotron harmonic damping as compared to the usual procedure of incoherently summing powers of individual radiators. This method has the advantage that phase information from localized radiating currents is globally retained so the directivity of the pickup antennas is correctly represented. Also standing waves and wall reflections are automatically included.

44458 **Effect of poloidal field on ion Bernstein waves.** Milovich, J.; Fried, B.D.; Morales, G.J. (University of California, Los Angeles, CA 90024-1547). *AIP (American Institute of Physics) Conference Proceedings;* **159**: No. 1, 398-401(Sep 1987). (CONF-870570—).

From 7. topical conference on applications of radio-frequency power to plasmas; Kissimmee, FL, USA (4 May 1987).

We have analyzed the effect of a small poloidal field on the propagation and absorption of electrostatic ion Bernstein waves in cylindrical geometry, assuming r/sub c//sub i//L<<1, L being the spatial scale length of the electrostatic potential Phi. For uniform axial current density, the helical field lines cause a shift in the effective k/sub parallel/, resulting in an asymmetry between waves propagating at the cyclotron resonance layer. Also, the radial dependence of k/sub perpendicular/ limits the radial extent of propagation. Solutions of Phi(r) for excitation by a localized antenna are given.

44459 **Electron heating by mode-converted ion-Bernstein waves in ICRF heating of tokamak plasmas.** Ram, A.K.; Bers, A. (Plasma Fusion Center, M.I.T., Cambridge, MA 02139). *AIP (American Institute of Physics) Conference Proceedings;* **159**: No. 1, 402-405(Sep 1987). (CONF-870570—).

From 7. topical conference on applications of radio-frequency power to plasmas; Kissimmee, FL, USA (4 May 1987).

In a tokamak plasma, ion-Bernstein waves (IBW) can be excited by mode-conversion of the externally launched fast wave for ICRF heating. This conversion process is known to be efficient for low k/sub parallel/'s which carry substantial power from a single loop antenna. A detailed numerical analysis of the propagation of the IBW shows that the initial small k/sub parallel/ are significantly enhanced along the rays due to toroidal effects. The upshift can occur for short radial distances of propagation and is large enough so that the IBW can Landau damp onto the electrons. This could help explain the observed strong electron heating by ICRF waves in tokamak plasmas. The numerical ray trajectory analysis is done in toroidal geometry for a hot Maxwellian plasma with gradients in temperature, density, toroidal and poloidal magnetic fields included in a WKB sense. A simple analytical model is derived which explains the upshift in k/sub parallel/ and gives results very close to the numerically obtained values. Approximate analytical conditions for appreciable electron Landau damping of the IBW are also given.

44460 Congruent reduction and mode conversion in 4-dimensional plasmas. Friedland, L.; Kaufman, A.N. (LBL and Physics Department, University of California, Berkeley, CA 94720). *AIP (American Institute of Physics) Conference Proceedings;* **159**: No. 1, 434-437(Sep 1987). (CONF-870570—).

From 7. topical conference on applications of radio-frequency power to plasmas; Kissimmee, FL, USA (4 May 1987).

Standard eikonal theory reduces, to N = 1, the order of the system of equations underlying wave propagation in inhomogeneous plasmas. The condition for this remarkable reducibility is that only one eigenvalue of the unreduced N x N dispersion matrix D(k,x) vansihes at a time. If, however, two or more eigenvalues of D become simultaneously small, the geometric optics reduction scheme becomes singular. These regions are associated with linear mode conversion, and are described by higher order systems. We develop a new reduction scheme based on congruent transformations of D, and show that in "degenerate" plasma regions, a partial reduction of order is possible. The method comprises a constructive step-by-step procedure, which, in the most frequent (doubly) degenerate case, yields a second order system, describing the pairwise mode conversion problem, the solution of which in general geometry has been found recently.

44461 Propagation of Langmuir waves in an inhomogeneous plasma. Fried, B.D.; Morales, G.J. (UCLA, Los Angeles, CA 90024). *AIP (American Institute of Physics) Conference Proceedings;* **159**: No. 1, 456-459(Sep 1987). (CONF-870570—).

From 7. topical conference on applications of radio-frequency power to plasmas; Kissimmee, FL, USA (4 May 1987).

The integral equation for Langmuir wave propagation excited by both localized antennae and sinusoidal beat waves is solved for an inhomogeneous plasma with constant density gradient. Comparison of the kinetic and fluid solutions shows clearly the effects of spatial Landau damping in the kinetic case.

44462 Power-balance analysis of muon-catalyzed fusion-fission hybrid reactor systems. Miller, R.L.; Krakowski, R.A. (Controlled Thermonuclear Research Div., Los Alamos National Lab., Los Alamos, NM (US)). pp 176-186 of Contributions to the muon catalyzed fusion workshop. Idaho Falls, ID; Idaho National Engineering Lab. (1985). (CONF-840660—).

From Workshop on muon-catalyzed fusion reactions; Jackson, WY, USA (7 Jun 1984).

A power-balance model of a muon-catalyzed fusion system in the context of a fission-fuel factory is developed and exercised to predict the required physics performance of systems competitive with either pure muon-catalyzed fusion systems or thermonuclear fusion-fission fuel factory hybrid systems.

44463 Theoretical study of the reactivation efficiency of the μ-meson catalyzed fusion reaction. Takahashi, H. (Dept. of Nuclear Energy, Brookhaven National Lab., Upton, NY (US)). pp 13 of Contributions to the muon catalyzed fusion workshop. Idaho Falls, ID; Idaho National Engineering Lab. (1985). (CONF-840660—).

From Workshop on muon-catalyzed fusion reactions; Jackson, WY, USA (7 Jun 1984).

The theoretical upper limit for μ/sup -/ catalyzed DT fusion reactions per μ/sup -/ meson is limited by 1/W/sub s/, where W/sub s/ is the sticking factor of the μ/sup -/ meson to the fusion product α-particle. The muonic helium ion (αμ) formed from the μ/sup -/ meson stickes to fusion product α-particle has an initial kinetic energy: E/sub αμ/ = 3.5 MeV. This muonic helium slows down like a heavy proton through a series of ionization collision with the surrounding molecules. On the other hand, before the kinetic energy becomes smaller than the appropriate threshold, as a consequence of several reactions, the (αμ) ion can be stripped and the muon can be made available again for the cycle of the fusion reaction. The reactivation efficiency are calculated using the several theoretical model for the cross sections, and the isotope and density effects of the target elements are studied. Due to the comparatively large mass of μ/sup -/ meson, the μ/sup -/ meson transfer for a tritium has large cross section than deutron or hydrogen (proton) in the low energy. At high energy region, the cross section for tritium is smaller than the deutron or hydrogen, but the stripping process is mostly due to the ionization process instead of μ/sup -/-meson transfer process in this high energy region. Thus, the reactivation efficiency for tritium target becomes about 10-20% higher than the dueteron or proton target. The authors' calculation for the transfer cross section is based on the Born approximation which is not so accurate for the low energy region and the present status of the cross section evaluation in low energy is not satisfactory. This requires more careful study.

44464 Systems concepts. Miley, G.H. (Fusion Studies Lab., Univ. of Illinois, 103 S. Goodwin Ave., Urbana, IL (US)). pp 13 of Contributions to the muon catalyzed fusion workshop. Idaho Falls, ID; Idaho National Engineering Lab. (1985). (CONF-840660—).

From Workshop on muon-catalyzed fusion reactions; Jackson, WY, USA (7 Jun 1984).

Best estimates to date for muon catalyzed D-T fusion are that an energy gain of — 0.6 is possible. This result is encouraging but not yet adequate for an economic future energy system. At least four possible solutions exist: (1) new data (e.g., temperature dependence of reaction constants) are obtained that suggest directions to an improved energy balance; (2) new basic concepts, reactions, etc. are developed that offer higher energy gains; (3) unique direct energy extraction techniques are developed that permit low energy gains; and/or (4) unique new applications are identified (e.g., estimates are that a hybrid system would increase the energy gain to — 7). Indeed, some combination of all four routes may evolve. The present discussion will consider potential directions in each and consider the implications to potential future energy systems.

44465 Muon catalytic fusion power reactor. Jarnagin, W.S. pp 14 of Contributions to the muon catalyzed fusion workshop. Idaho Falls, ID; Idaho National Engineering Lab. (1985). (CONF-840660—).

From Workshop on muon-catalyzed fusion reactions; Jackson, WY, USA (7 Jun 1984).

Three main ideas are proposed using negative muoun catalyis in a fusion power reactor. Firstly, let low energy muons attack the lower end of a (dense plasma's distribution curve. This simultaneously helps clear the plasma of slow particles (by fusing them) and raises the plasma's average temperature. Concurrently, the upper end of the distribution curve is attacked as usual (here, with plasma beams from built-in reaccelerators). Secondly, let deuterium or tritium be substituted for hydrogen in the chemical formation of boron-hydrides or other macromelecular fuel. Thence fusion of clusters of (DTμ-) by thermal muons may ignite whole macromelecules. Energy release could be great. For instance, the large icosahedron (B/sub 12/H/sub 12/)/sup -2/, with D-T substitutions for H--at least in places--may release on the order of 300 MeV energy. A single muon (costing about 5 GeV)catalyzing the fusion of 100 of these macromolecules could, in principle, release about 30 GeV energy. Thirdly, it may be possible to reaccelerate muons back up to relativistic energies before they decay (to electrons, neutrions, antineutrinos). If so, then by relativity theory, their decay clocks should be reset, that is, their lifetime re-established. This should be significantly cheaper in energy than producing new pions which decay to muons. This step alone may be sufficient to yield net power from muon catalysts.

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REFER ALSO TO CITATION(S) 43650, 43745, 44305, 44386, 44392, 44462

44466 (AU/EE—051983) High power krypton fluoride laser development for fusion energy research. Final report. (Alberta Univ., Edmonton (Canada). Dept. of Electrical Engineering). May 1983. 83p. (CE—01618). CANMET/TID, Energy, Mines and Resources Canada, 555 Booth St., Ottawa, Ont., Canada K1A 0G1; $0.34CAN per page, $3.40 CAN minimum.

This report describes progress achieved on a laser development program, the goal of which has been to establish a first generation short wavelength KrF laser facility capable of delivering nominally 20 J in 5 ns pulses for inertial confinement fusion re-

search at irradiation intensity levels up to 5 x 10/sup 13/ watts/cm/sup 2/. The KrF discharge laser front end is a subsystem utilizing a multi-etalon contolled master oscillator with 3 amplifiers. A portion of the output is used to laser trigger the high voltage switches on the A-amplifer, a second portion to generate a pulse used for extraction of the A-amplifier and eventual pulse stacking, and a final portion to generate a Stokes shifted optical pulse in methane and for subsequent pulse in methane and for subsequent pulse shaping. The resulting pulse is used to seed the Raman compressor. Here the short seed pulse is counterpropagated with the stacked output of the A-amplifier in a final methane cell. By stimulated backward Roman scattering the energy from the A-amplifier is transferred to the short Stokes shifted seed pulse. The nominally 20 J, 5 ns output pulse will then be directed to the target chamber. A number of system up-grades have been incorporated, and a variety of issues related to front-end system performance have been studied, including beam polarization and temporal modulation effects, optical coatings and damage thresholds, dichroic mirrors, data acquisition and analysis. Fabrication, assembly and testing of the electron-beam pumped A-amplifier has been achieved during this year. This unit is the heart of the high energy laser output and so has received the greatest attention. Finally, extensive measurements have been made on Roman pulse generation and amplification. 21 figs., 33 refs.

44467 (CEA-CONF—9193) Multi-pellet injection in TFR. Geraud, A. (Association Euratom-CEA, Centre d'Etudes Nucleaires de Cadarache, 13 - Saint-Paul-lez-Durance (France). Dept. de Recherches sur la Fusion Controlee). 1987. 4p. (CONF-870629—). NTIS (US Sales Only), PC A02/MF A01. Order Number DE88753897/JAW.

From 14. European conference on controlled fusion and plasma physics; Madrid, Spain (22 Jun 1987).

Four successive hydrogen pellets have been injected into deuterium plasma of the TFR Tokamak (major radius R = 0.98 m, minor radius a = 0.2 m). Each pellet corresponds to 50 % of the initial average density and penetrates at about half radius. After filling up, the density profile generally hollow just after injection, evolves slowly towards a slightly more peaked shape. Transport analysis of the long time scale density relaxation shows generally no change in particle transport coefficients, except in a particular case where the time interval between two pellets has been reduced from {similar←to} 40 ms to {similar←to} 20 ms.

44468 (CONF-880505—28) Lithium test module on ITER: engineering design of the tritium recovery system. Finn, P.A. (Argonne National Lab., IL (USA)). 1988. Contract W-31-109-ENG-38. 13p. NTIS, PC A03/MF A01; 1; GPO Dep. Order Number DE88011967/JAW.

From 3. topical meeting on tritium technology in fission, fusion and isotopic applications; Toronto, Canada (1 May 1988).

The design presented is an overview of the tritium recovery system for a lithium module on an ITER type reactor. The design of a tritium recovery system for larger blanket units, sectors, etc. could use the information developed in this report. A goal of this design was to ensure that a reliable, integrated performance of the tritium recovery system could be demonstrated. An equally important goal was to measure and account for the tritium in the liquid lithium blanket module and its recovery system in order to validate the operation of the blanket module.

44469 (CONF-880505—29) Parameters important in the oxidation of tritium at a stainless steel surface. Finn, P.A.; Van Deventer, E.H. (Argonne National Lab., IL (USA)). 1988. Contract W-31-109-ENG-38. 17p. NTIS, PC A03/MF A01; 1; GPO Dep. Order Number DE88012063/JAW.

From 3. topical meeting on tritium technology in fission, fusion and isotopic applications; Toronto, Canada (1 May 1988).

The heterogeneous reaction between oxygen gas and permeating tritium is being studied at the back surface of an oxidized 316-stainless steel tube. The ratio between the reaction products collected at the back surface, tritiated water and molecular tritium, is determined as a function of oxygen level, tritium concentration, protium concentration, flow rate, and temperature. This report describes the results from two sets of runs done at 550°C with and without 15 ppm protium in the oxygen/helium gas. At oxygen levels of 1200-2000 ppm, the ratio of tritiated water to molecular tritium was >40, i.e., a 98% conversion. At oxygen levels of 40 ppm, the presence of excess protium in the oxygen/helium resulted in a reduced yield of tritiated water.

44470 (CONF-880613—14) Hardness and depth-dependent microstructure of ion-irradiated $MgAl_2O_4$. Zinkle, S.J. (Oak Ridge National Lab., TN (USA)). 1988. Contract AC05-84OR21400. 45p. (CONF-880613—14). NTIS, PC A03. Order Number DE88012497/JAW.

From 14. international symposium on effects of radiation on materials; Andover, MA, USA (27 Jun 1988).

Stoichiometric polycrystalline magnesium aluminate spinel has been irradiated at 25 and 650{degree}C with 2.4 MeV Mg/sup plus/ ions to a fluence of 1.4 {times} 10^{21} ions/m^2 ({approximately}35 dpa peak damage level). Microindentation hardness measurements and transmission electron microscopy combined with energy dispersive X-ray spectroscopy measurements were used to characterize the irradiation effects. The room-temperature hardness of spinel increased by about 5% after irradiation at both temperatures. There was no evidence for amorphization at either irradiation temperature. Interstitial-type dislocations loops lying on {1←brace}110{r←brace} and {1←brace}111{r←brace} planes with <110> Burgers vectors were observed at intermediate depths ({approximately}1 μm) along the ion range. The <110>{1←brace}111{r←brace} loops are presumably formed from <110>{1←brace}111{r←brace} loops as a result of a shear on the anion sublattice. Only about 0.05% of the calculated displacements were visible in the form of loops, which indicates that spinel has a high resistance to aggregate damage accumulation. The peak damage region contained a high density of dislocations tangles. There was no evidence for the formation of voids or vacancy loops. The specimen irradiated at 650{degree}C was denuded of dislocation loops within {approximately}1 μm of the surface. 25 refs., 16 figs., 5 tabs.

44471 (CONF-8710249—2) The thermal conductivity of beds of spheres. McElroy, D.L.; Weaver, F.J.; Shapiro, M.; Longest, A.W.; Yarbrough, D.W. (Oak Ridge National Lab., TN (USA)). 1987. Contract AC05-84OR21400. 19p. NTIS, PC A03/MF A01; 1; GPO Dep. Order Number DE88012928/JAW.

From 29. international thermal conductivity conference; Blacksburg, VA, USA (19 Oct 1987).

The thermal conductivities (k) of beds of solid and hollow microspheres were measured using two radial heat flow techniques. One technique provided k-data at 300 K for beds with the void spaces between particles filled with argon, nitrogen, or helium from 5 kPa to 30 MPa. The other technique provided k-data with air at atmospheric pressure from 300 to 1000 K. The 300 K technique was used to study bed systems with high k-values that can be varied by changing the gas type and gas pressure. Such systems can be used to control the operating temperature of an irradiation capsule. The systems studied included beds of 500 μm dia solid Al_2O_3, the same Al_2O_3 spheres mixed with spheres of silica--alumina or with SiC shards, carbon spheres, and nickel spheres. Both techniques were used to determine the k-value of beds of hollow spheres with solid shells of Al_2O_3, Al_2O_3{center←dot}7 w/o Cr_2O_3, and partially stabilized ZrO_2. The hollow microspheres had diameters from 2100 to 3500 μm and wall thicknesses from 80 to 160 μm. 12 refs., 7 figs., 4 tabs.

44472 (DOE/DP/40200—69) Alternative analysis of CO_2-laser-produced plasma waves. Simon, A.; Short, R.W. (Rochester Univ., NY (USA). Lab. for Laser Energetics). Feb 1988. Contract FC08-85DP40200. 17p. NTIS, PC A03/MF A01;1; GPO Dep. Order Number DE88008434/JAW.

McIntosh has carried out experiments in which electron plasma waves produced in a gas jet target by a CO_2 laser pulse were studied by picosecond-resolution Thomson scattering of a ruby laser pulse. In addition, spectra of the scattered laser light and of the fast electron were obtained. Their analysis of the data was based on the assumption that the plasma waves are created by onset of the stimulated Raman scattering instability. This led to a number of difficulties in the interpretation of the data. We show here that an alternative model of the origin of these plasma waves used previously in analyzing Raman data in several other experiments, removes all these difficulties and is in agreement with the data. In

this model, the plasma waves are produced by pulses of fast electrons arising at the quarter-critical surface.

44473 **(GA-A—19327) DIII-D Vessel Modification Project: Final report for the period FY83 through FY86.** Davis, L.; Luxon, J.; Anderson, P.; Callis, R.; Colleraine, A.; Rock, P.; Stambaugh, R. (General Atomics Co., San Diego, CA (USA)). Jun 1988. Contract AT03-76ET51011;AC03-84ER51044. 183p. NTIS, PC A09/MF A01; 1; GPO Dep. Order Number DE88013630/JAW.

The DIII-D device is a large tokamak used for experimental research into the physics and technologies needed for the application of fusion energy to the needs of society. DIII-D is located in San Diego, California on a site provided by General Atomics (GA). The device was originally constructed under DOE (then ERDA) contract as Doublet III and commissioned in early 1978. The device has since been operated, upgraded, and through this project, modified (to DIII-D) under contract to DOE. The DIII-D Vessel Modification Project was partially funded by the Japan Atomic Energy Research Institute (JAERI) as part of a nine-year cooperative research program on Doublet III. In addition, JAERI funds provided for earlier major upgrades to the DIII facility, particularly in the power and neutral beam heating systems. These upgrades have been fully incorporated into the DIII-D facility. This report summarizes the scope, cost, and schedule of the Vessel Modification Project, and indicates any major changes that were made as the project progressed. Numerous separate scientific and engineering papers describe more fully the details of the design and expected performance of the device and are referenced in the Appendices.

44474 **(HIFT—140) Self-organization in three-dimensional compressible magnetohydrodynamic flow.** Horiuchi, Ritoku; Sato, Tetsuya. (Hiroshima Univ. (Japan). Inst. for Fusion Theory). Jul 1987. 47p. NTIS (US Sales Only), PC A03/MF A01. Order Number DE88753407/JAW.

A three-dimensional self-organization process of a compressible dissipative plasma with a velocity-magnetic field correlation is investigated in detail by means of a variational method and a magnetohydrodynamic simulation. There are two types of relaxation, i.e., fast relaxation in which the cross helicity is not conserved, and slow relaxation in which the cross helicity is approximately conserved. In the slow relaxation case the cross helicity consists of two components with opposite sign which have almost the same amplitude in the large wavenumber region. In both cases the system approaches a high correlation state, dependent on the initial condition. These results are consistent with an observational data of the solar wind. Selective dissipation of magnetic energy, normal cascade of magnetic energy spectrum and inverse cascade of magnetic helicity spectrum are observed for the sub-Alfvenic flow case as was previously observed for the zero flow case. When the flow velocity is super-Alfvenic, the relaxation process is significantly altered from the zero flow case.

44475 (INIS-mf—11210, pp V21-V24) **Minimum thickness blankets for fusion reactors.** Karni, Y.; Greenspan, E. (Israel Atomic Energy Commission, Beersheba. Nuclear Research Center-Negev; Israel Atomic Energy Commission, Tel Aviv). Dec 1987. NTIS (US Sales Only), PC A13/MF A01. Order Number DE88780087/JAW. (CONF-871287—).

From Nuclear Societies of Israel annual meeting; Haifa, Israel (21 Dec 1987).

Transactions.; V. 14.

44476 (INIS-mf—11210, pp V29-V32) **MHD heat-transfer enhancement possibilities in fusion reactors.** Sukoriansky, S.; Branover, H.; Klaiman, D.; Greenspan, E. (Ben-Gurion Univ. of the Negev, Beersheba (Israel). Center for MHD Studies; Israel Atomic Energy Commission, Tel Aviv). Dec 1987. NTIS (US Sales Only), PC A13/MF A01. Order Number DE88780087/JAW. (CONF-871287—).

From Nuclear Societies of Israel annual meeting; Haifa, Israel (21 Dec 1987).

Transactions.; V. 14.

44477 **(INIS-mf—11210) Annual Meeting 1987.** (Israel Nuclear Society, Yavne). Dec 1987. vp. (CONF-871287—). NTIS (US Sales Only), PC A13/MF A01. Order Number DE88780087/JAW.

From Nuclear Societies of Israel annual meeting; Haifa, Israel (21 Dec 1987).

Transactions.; V. 14.

Individual papers in this meeting were abstracted separately. DWL

44478 **(IPPJ—856) Magneto-inertia confinement approach (MICA) to fusion in dynamic Z-pinch formed from a frozen deuterium-tritium tube.** Ikuta, Kazunari. (Nagoya Univ. (Japan). Inst. of Plasma Physics). Nov 1987. 10p. NTIS (US Sales Only), PC A02/MF A01. Order Number DE88753417/JAW.

This paper reconsiders the magneto-inertia confinement approach to fusion in dynamic z-pinch with a new method of generating a hot plasma using a frozen deuterium tube as a initial condition. We will see that the technology of fabricating deuterium ice tube at the present time is available if the modern pulsed power technology could induce the high current of order 10 MA along the tube. The dense z-pinch plasma formed from the electro-magnetical implosion of thin tubular deuterium-tritium (D-T) ice with radius of about 1 mm can satisfy the Lawson criterion, provided that its length is 1 cm.

44479 **(JAERI-M—87-203) Fusion neutron shielding benchmark problems.** Oka, Yoshiaki; Sasamoto, Nobuo; Mori, Seiji. (Japan Atomic Energy Research Inst., Tokyo). Dec 1987. 236p. (In Japanese). NTIS (US Sales Only), PC A11/MF A01. Order Number DE88753419/JAW.

Fusion neutron shielding benchmark problems are prepared, based on shielding experiments using D-T neutron sources. The problems are compiled according to the four types of experiments, (1) transmission, (2) streaming, (3) skyshine and backscattering and (4) induced activities. The format of the description is the same as that of the previous two reports of the shielding benchmark problems, JAERI-M 7843 and 8686. The present report does not include the experiments on lithium due to the time and space limitations.

44480 **(JAERI-M—87-205) Recent results from JT-60.** Nagami, Masayuki; Abe, T.; Aikawa, H. (Japan Atomic Energy Research Inst., Tokyo). Jan 1988. 33p. NTIS (US Sales Only), PC A03/MF A01. Order Number DE88753420/JAW.

During the last several months of JT-60 operation, experiments in hydrogen plasmas have been undertaken with up to 3.2 MA of plasma current in limiter discharges, 2.7 MA in divertor discharges, and 30 MW of total NB (H^0 -> H^+) and RF injection power. In limiter discharges with ~ 3 MA plasma current, the maximum central electron density of 1.3 x 10^{20} m^{-3} and the energy confinement time of 0.15 - 0.18 sec were obtained with heating powers of 13 - 20 MW. The total plasma stored energy of 3.1 MJ, and n/sub e/(0)tau/sub E/ of 1.4 - 1.8 x 10^{19} m^{-3} sec were achieved. Many short periods (50 - 100 ms) of H-mode phase are found in outside X-point divertor discharges with NB or NB + RF (LH or IC) heating power of more than 16 MW, although at present the energy confinement improvement is limited to within 10 %. In combined LH and NB heating of low-n-bar/sub e/ discharge, the plasma stored energy increases with the same rate as NB heating only, with preferential absorption of LH wave to the high energy beam ions. In combined NB and on-axis ICRF heating of low-n-bar/sub e/ discharge, a high incremental energy confinement time is obtained, with strong high energy beam ion acceleration and electron heating in the central region of the plasma.

44481 **(JAERI-M—87-214) Stability experimental results of cable-in-conduit superconductor for fusion.** Tada, Eisuke. (Japan Atomic Energy Research Inst., Tokyo). Jan 1988. 105p. (In Japanese). NTIS (US Sales Only), PC A06/MF A01. Order Number DE88753424/JAW.

In case of the forced-flow cooling, the design basis should be established regarding the stability, the static pressure drop and the transient pressure rise during quench which are more serious than

that of the pool-boiling cooling coils by liquid helium. For this purpose, JAERI constructed a 15-kA cable-in-conduit conductor whose major parameters is based on a real conductor of FER and measured the stability, the pressure drop, and the pressure rise characteristics by using the Superconducting Engineering Test Facility (SETF). The following conclusions are obtained by this experiments in which a disturbance is applied to a part of the conductor by an inductive heater for a heating time duration of 6 msec. 1) Two types of quench, which are quench at the heated zone and at the down stream region, are observed and the down stream quench is serious for the forced-flow cooling coils because the down stream quench is caused by a lesser disturbance than the heated zone. 2) The heated zone conductor is cooled by a transient heat transfer and an induced flow which give a higher cooling capability than the steady flow in the down stream region. The calculated stability characteristics by an analysis code "ALPHE-II" are in good agreement with the measured value. 3) The down stream quench is caused by hot helium flowing from the heated zone to the down stream and the stability margin measured is in good agreement with the calculated value by a simple energy balance based on the quasi-static process. 4) The friction factor of a cable-in-conduit conductor has a smooth slope and is in good agreement with the equation for turbulent flow. In addition, the friction factor is roughly twice that of a smooth tube. 5) The pressure rise obtained in a full quench condition is in good agreement with the calculated value by the ALPHE-II and linearly increases as the heating energy to the helium is increased.

44482 **(ORNL/TM—10728) Generomak: Fusion physics, engineering and costing model.** Delene, J.G.; Krakowski, R.A.; Sheffield, J.; Dory, R.A. (Oak Ridge National Lab., TN (USA)). Jun 1988. Contract AC05-84OR21400. 75p. NTIS, PC A05/MF A01; 1; GPO Dep. Order Number DE88013507/JAW.

A generic fusion physics, engineering and economics model (Generomak) was developed as a means of performing consistent analysis of the economic viability of alternative magnetic fusion reactors. The original Generomak model developed at Oak Ridge by Sheffield was expanded for the analyses of the Senior Committee on Environmental Safety and Economics of Magnetic Fusion Energy (ESECOM). This report describes the Generomak code as used by ESECOM. The input data used for each of the ten ESECOM fusion plants and the Generomak code output for each case is given. 14 refs., 3 figs., 17 tabs.

44483 **(SAND—87-2452) High heat flux testing of CIT [Compact Ignition Tokamak] first wall tiles.** Watson, R.D.; Croessmann, C.D.; Watkins, J.G.; Dempsey, J.F. (Sandia National Labs., Albuquerque, NM (USA)). Mar 1988. Contract AC04-76DP00789. 163p. NTIS, PC A08/MF A01;1; GPO Dep. Order Number DE88012241/JAW.

Sandia National Laboratories' Fusion Technology Divison has performed a series of tests in support of the Compact Ignition Tokamak (CIT) first wall tile design. First, a screening study was done to rank the thermal shock resistance of 25 candidate graphite materials. Intense heat pulses generated by the electron beam test system cracked most of the fine-grained graphites but did not fracture any of the carbon/carbon composite samples. The best performing fine-grained graphites were Union Carbide's TS-1792, TS-1909, and ATJ-S; as well as Fiber Material's type HDG. Next, mechanical tests were performed on prototype first wall tiles made of POCO AXF-5Q, and an FMI 4-D carbon/carbon nut, both designed and fabricated by GA Technologies, Inc. These tests included static tension, compression, and bending loads, as well as dynamic vibration and shock loading. Failure analysis indicates that the carbon/carbon composite nut is the weak link in the design. A resonant frequency of 2000 Hz was measured. The tile assembly survived 3000 transient shock pulses of 350 g acceleration over a 100 ms duration. Finally, ion beam heating tests were performed on prototype tile assemblies. The tile survived peak heat pulses of 1000 W/cm^2 for 4 s and 1500 W/cm^2 for 3 s without damage. These heat loads exceed design requirements of 850 W/cm^2 for 3.2 s. However, a thermal stress crack in the POCO AXF-5Q tile was observed at a power level of 2000 W/cm^2 after 2 s. 58 figs., 10 tabs.

44484 **(SAND—88-1007) Two dimensional magnetohydrodynamic simulations of magnetic field penetration in the plasma opening switch.** Payne, S.S. (Sandia National Labs., Albuquerque, NM (USA)). Jun 1988. Contract AC04-76DP00789. 129p. NTIS, PC A07/MF A01; 1; GPO Dep. Order Number DE88012747/JAW.

Magnetic field penetration has been investigated in computer simulations of Sandia's and the Naval Research Laboratory's (NRL) plasma opening switch (POS). POS simulations have been performed using the two-dimensional (2-D), two-temperature, magnetohydrodynamic (MHD), single fluid code HAM. Four particular penetration mechanisms considered are: (1) the Chodura model based on the ion-acoustic instability where the saturated value of the anomalous collision frequency is approximated by the ion plasma frequency, (2) a model based on the lower hybrid instability in which the anomalous collision frequency is proportional to both the ion plasma frequency and the electron drift velocity, (3) a model which limits the ion drift velocity to the plasma influx velocity and (4) a penetration model based on a self consistent union of the Buneman, generalized ion-acoustic and lower-hybrid instabilities. 2-D MHD calculations of the POS are presented that show these models to be qualitatively similar for densities above a few 10^{13}, though at lower densities they can be quite different. The calculations are compared to experiments and some agreement is seen to the lower hybrid model with best agreement to experiment found with the self consistent penetration model. The other models compare only marginally to experimental results. 41 refs., 30 figs., 5 tabs.

44485 **(SAND—88-1010C) New diagnostic developments for intense ion beam experiments.** Leeper, R.J. (Sandia National Labs., Albuquerque, NM (USA)). 1988. Contract AC04-76DP00789. 10p. (CONF-880713—2). NTIS, PC A02/MF A01; 1; GPO Dep. Order Number DE88012388/JAW.

From 7. international conference on high-power particle beams; Karlsruhe, F.R. Germany (4 Jul 1988).

A review of recent developments in intense ion beam diagnostics used in the international light ion inertial confinement fusion (ICF) programs will be presented. These developments have occurred in each of the several generic classes of diagnostics, namely, imaging diagnostics, particle spectrograph diagnostics, nuclear activation, and visible spectroscopy. Critical beam parameters measured by the new diagnostics include spatial profile, absolute number, species, anode plasma temperature and density, voltage, current density, and power density. A unique feature of most of these diagnostics is that they are capable of operating in hard (multi-MeV) x-ray bremsstrahlung backgrounds of some 10^9-10^{10} rad/s. The operating principles of each diagnostic will be summarized in the paper with examples of how the diagnostics may be integrated together to form a complete diagnostic system. The paper will close with a discussion of two new data acquisition systems that have been developed for intense beam diagnostics. 30 refs.

44486 **(SAND—88-1729C) Target fabrication of current pulsed-power driven x-ray laser targets.** Wiemann, D.K.; Bieg, K.W. (Sandia National Labs., Albuquerque, NM (USA)). 1988. Contract AC04-76DP00789. 10p. (CONF-8806170—1). NTIS, PC A02/MF A01; 1; GPO Dep. Order Number DE88012333/JAW.

From 6. target fabrication specialist's meeting; Los Alamos, NM, USA (19 Jun 1988).

The goal of the NARYA program at Sandia National Laboratories is to make a pulsed-power driven x-ray laser. Ongoing experiments on the 10 TW, 5 MA accelerator, PROTO II, have required a wide range of thin-walled, hollow cylindrical targets called soda straws. A typical soda straw consists of an inner lasant layer, a Parylene strong back layer, and an outer converter layer. Variations to this have been targets of plain Parylene straws, straws with only lasant layers, and straws with only converter layers. These straws are nominally 1.6, 3, or 6 mm in diameter and 20 mm in length. Additional components to the straws have been solid cones coated with a lasant laser of vanadium mounted within the straws. Cone specifications are shown. The solid cones have a base diameter of either 3 or 6 mm and extend 2/3 the way up the straw with a tip radius of 127 μm. Target parameters for the straws have

been the following: the inner coatings ranging from 100-1000 A of vanadium, nickel, or copper; the Parylene thicknesses ranging from 1.8 - 5.0 μm; and the outer coatings ranging from 100-500 A of silver or barium, 500-4000 A of aluminum, or 2000-10,000 A of sodium fluoride. The requirements for the cones have been 4000 A and 400 A of vanadium.

44487 **(SFTI—87-9) Generator of current pulses with increased duration and small pulse rise time.** Stotland, M.A. (Gosudarstvennyj Komitet po Ispol'zovaniyu Atomnoj Ehnergii SSSR, Sukhumi. Fiziko-Tekhnicheskij Inst.). 1987. 5p. (In Russian). NTIS (US Sales Only), PC A02/MF A01. Order Number DE88703804/JAW.

A new scheme of generator of current pulses with a capacitive accumulator, sectionalized induction load and valves (i.e diodes) is described. Unlike in earlier applied schemes the shortening of the pulse rise time and increase in the duration of pulse plateau is achieved by automatic (arbitrary) current recommutation close to its maximum from valves ensuring paralllel connection of induction load sections on valves ensuring their series connection. 3 refs.; 2 figs.

44488 **Heating of a dense plasma using a relativistic electron beam.** Benage J.F. Jr.; Jones, L.A.; Kania, D.R.; Begay, F. (Physics Division, Los Alamos National Laboratory, Los Alamos, New Mexico 87545). *Journal of Applied Physics;* **64**: No. 4, 1748-1752(15 Aug 1988).

We have carried out an experiment to measure the heating of a dense carbon plasma, n/sub e/$\sim 10^{18}$—10^{19} cm^{-3}, by a relativistic electron beam. Using spectroscopic methods, the temperature of the plasma was measured. By taking into consideration the heat loss mechanisms in the plasma, the amount of energy deposited into the plasma by the beam was determined. The results are consistent with theoretical predictions.

44489 **Analytic solutions for Rayleigh-Taylor growth rates in smooth density gradients.** Munro, D.H. (Lawrence Livermore National Laboratory, University of California, Livermore, California 94550). *Physical Review [Section] A: General Physics;* **38**: No. 3, 1433-1445(1 Aug 1988).

The growth rate of perturbations on the shell of a laser fusion target can be estimated as $\sqrt{gk}$, where g is the shell acceleration and k is the transverse wave number of the perturbation. This formula overestimates the growth rate, and should be modified for the effects of density gradients and/or ablation of the unstable interface. The density-gradient effect is explored here analytically. With the use of variational calculus to explore all possible density profiles, the growth rate is shown to exceed $\sqrt{gk/(1+kL)}$, where L is a typical density-gradient scale length. Density profiles actually exhibiting this minimum growth rate are found.

44490 **Microwave measurement of the mass of frozen hydrogen pellets.** Talanker, V.; Greenwald, M. (Plasma Fusion Center, Massachusetts Institute of Technology, Cambridge, Massachusetts 02139). *Review of Scientific Instruments;* **59**: No. 7, 1085-1087(Jul 1988).

A nondestructive method for measuring the mass of high-speed, frozen hydrogen pellets is described. The measurement technique is an improvement on previous methods based on the perturbation to a resonant cavity caused by a dielectric pellet passing through the cavity. In the new method, an oscillator circuit is formed with a resonant cavity in the positive feedback loop of a microwave power amplifier. An injected pellet perturbs the resonance characteristics of the cavity causing a shift in the operating frequency of the oscillator proportional to the ratio of the pellet volume to the volume of the cavity. Through digital measurement of the frequency shift the size of the pellet is determined automatically. In a "proof-of-principle" experiment it was shown that polyethylene pellets, with an average volume of 0.26 mm^3 and velocity ≃500 m/s, caused a shift in the operating frequency of the oscillator circuit that was within 10% of the predicted value. The hydrogen pellets (of interest to us) will have 4—10 x the volume of the plastic pellets. Thus with a dielectric constant of about 1.26 for frozen hydrogen, the signals in the actual experiment would be 1—2 x those described here.

44491 **Gain scaling relations - Heavy-ion targets.** Magelssen, G.R. (Los Alamos National Lab., Group X-1, Mail Stop E531, Los Alamos, NM (US)). *Fusion Technology;* **13**: No. 2, 339-347(Feb 1988).

Scaling relationships among the relevant reactor, driver, and target parameters and gain for three heavy-ion target concepts are presented. These relations include scaling laws for the required peak power and ion energy, the fuel fractional burnup, and the fraction of energy released in charged particles and X rays as a function of the target radius, the hydrodynamic coupling efficiency, and the incident ion energy. The impact of polarized deuterium-tritium fuel on the scaling relations is also shown, and the direct-drive concept is examined to illustrate some of the ideas used in developing a hydrodynamic efficiency model.

44492 **High speed detection of thermonuclear neutrons with solid state detectors.** Kania, D.R.; Lane, S.; Jones, B.; Bennett, C. (Lawrence Livermore National Lab., Univ. of California, P.O. Box 5508, L-473, Livermore, CA (US)). *IEEE (Institute of Electrical and Electronics Engineers) Transactions on Nuclear Science;* **35**: No. 1, 387-388(Feb 1988). (CONF-871006—).

From 34. nuclear science symposium and 19. nuclear power systems symposium; San Francisco, CA, USA (21 Oct 1987).

Inertial confinement fusion experiments generate thermonuclear neutrons on subnanosecond time scales. To understand the burning of DT fuel, the authors developed a 14 MeV neutron detector with subnanosecond time response. The detectors are made of neutron damaged, bulk GaAs with electron-hole recombination times of 60 ps. The conductivity of the detector is modulated by the energy deposited by the neutrons interacting in the detector that create free carriers. The fast electron hole recombination time of this material quickly removes these radiation generated carriers from the conduction process resulting in extremely fast response times. The measurements and calculations of the sensitivity of these detectors to 14 MeV neutrons are in good agreement.

44493 **Sensitivity of electricity cost to heavy-ion fusion target characteristics.** Wilson, D.C.; Dudziak, D.J.; Magelssen, G.R.; Zuckerman, D.S.; Driemeyer, D.E. (Los Alamos National Lab., Los Alamos, NM (US)). *Fusion Technology;* **13**: No. 2, 333-338(Feb 1988).

The systems model for a commercial electric power facility produced by the Heavy-Ion Fusion Sshytem Assessment is used to study the sensitivity of electricity cost to various inertial confinement fusion target characteristics including gain, peak power, ion range, and target fabrication cost. Net electric power from the plant was fixed at 1000 MW(electric) to eliminate large effects caused by economies of scale. An improved target cost model is used and compared with earlier results. Although specific quantitative results changed, the earlier general conclusions remain valid. The system is moderately insensitive to target gain. A factor of 2.5 change in gain causes <10% change in electricity cost. Increased peak power needed to drive targets poses only a small cost risk but requires many more beamlets be transported to the target. Shortening the required ion range causes both cost and beamlet difficulties. A factor of 4 decrease in the required range at a fixed driver energy increases electricity cost by 43% and raises the number of beamlets from 34 to 330. Finally, the heavy-ion fusion system can accommodate large increases in target costs. While moderate target gain is required, to address the other major uncertainties target design should concentrate on understanding requirements for ion range and peak driver power.

44494 **Targets for heavy-ion fusion.** Bangerter, R.O. (Univ. of California, Lawrence Livermore National Lab., Livermore, CA (US)). *Fusion Technology;* **13**: No. 2, 348-355(Feb 1988).

The cost of an accelerator depends strongly on the requirements that it must satisfy to drive a target. Therefore, an important part of the Heavy-Ion Fusion Systems Assessment (HIFSA) Project has been a search for, and an assessment of, target concepts that might relax the accelerator requirements. This paper outlines the considerations that have guided the search for improved targets and gives a brief description of the various concepts that have been

studied. Not all of the target concepts were sufficiently developed for inclusion in the HIFSA study and are discussed here for completeness. Recent work has led to new estimates of the gain of radiatively driven targets. This work was not completed in time for the HIFSA study, but is included in this paper. Although the new results differ substantially from the base case used in this study, a systems study performed at Lawrence Livermore National Laboratory shows that the new results increase the cost of electricity by slightly less than 10%.

44495 TFTR ICRF antenna design. Wilson, J.R.; Bialek, J.; Bonanos, P.; Brookes, A.; Colestock, P.L.; Hosea, J.C.; Lehrman, I.; Ritter, R. (Princeton University, Plasma Physics Laboratory, Princeton, New Jersey 08544). *AIP (American Institute of Physics) Conference Proceedings;* **159**: No. 1, 294-297(Sep 1987). (CONF-870570—).

From 7. topical conference on applications of radio-frequency power to plasmas; Kissimmee, FL, USA (4 May 1987).

An antenna for ICRF heating via the fast magnetosonic wave has been designed for the TFTR tokamak. The antenna will operate at 47 MHz and is designed to couple ~5 MW of rf power to the plasma. Detailed mechanical and thermal analyses have been performed to verify that the design is compatible with the heat fluxes and mechanical stresses of the TFTR environment.

44496 Tests of a high-power folded waveguide coupler for ICRF heating. Owens, T.L.; Chen, G.L.; Haste, G.R.; Ryan, P.M. (Oak Ridge National Laboratory, Oak Ridge, TN 37831). *AIP (American Institute of Physics) Conference Proceedings;* **159**: No. 1, 298-301(Sep 1987). (CONF-870570—).

From 7. topical conference on applications of radio-frequency power to plasmas; Kissimmee, FL, USA (4 May 1987).

A full-scale folded waveguide coupler has been fabricated which will provide information on power handling, impedance matching, and multipactor effects. The coupler dimensions are 30 x 60 x 300 cm. The cross section of the coupler is small enough that a phased pair of couplers could be placed in a single Tore Supra or TFTR port. A single coupler could be placed in a CIT-size port. A movable back plate allows frequency adjustment over the range 78—140 MHz. Impedance matching at the waveguide has been achieved using a movable coaxial transmission line feed. Bench-top comparisons with loop antennas have been made. The folded waveguide coupler will be mounted on the Radio Frequency Test Facility for high-power tests up to 1.5 MW.

44497 Design of high-power ICRF antennas for TFTR and Tore Supra. Hoffman, D.J.; Baity, F.W.; Bryan, W.E.; Chen, G.L.; Luk, K.H.; Owens, T.L.; Ray, J.M.; Ryan, P.M.; Swain, D.W.; Walls, J.C.; and others. (Oak Ridge National Laboratory, P.O. Box Y, Oak Ridge, TN 37831). *AIP (American Institute of Physics) Conference Proceedings;* **159**: No. 1, 302-305(Sep 1987). (CONF-870570—).

From 7. topical conference on applications of radio-frequency power to plasmas; Kissimmee, FL, USA (4 May 1987).

The Oak Ridge National Laboratory is designing, fabricating, and testing antennas for TFTR and Tore Supra. The antennas will deliver 4 MW per port to the hot plasma. The antennas' designs are nearly complete; they are backed by the results of extensive modeling, analyses, and tests of the electrical, thermal, and structural characteristics of the antennas that were carried out during the design process.

44498 ICRF power capacity of water-filled waveguides. Moses, K.G. (JAYCOR, Plasma Technology Division, Torrance, CA 90503). *AIP (American Institute of Physics) Conference Proceedings;* **159**: No. 1, 310-313(Sep 1987). (CONF-870570—).

From 7. topical conference on applications of radio-frequency power to plasmas; Kissimmee, FL, USA (4 May 1987).

The λ power-carrying capacity of liquid-filled waveguides is reported. Water is used because of its large relative dielectric constant, high heat capacity, low cost, availability, and well-known chemistry and technology. (AIP)

44499 Analysis and experiments for a waveguide launcher in the ICRF for tokamaks with divertors. Lam, N.T.; Lee, J.L.; Eldridge, O.C.; Scharer, J.E. (University of Wisconsin, Madison). *AIP (American Institute of Physics) Conference Proceedings;* **159**: No. 1, 314-317(Sep 1987). (CONF-870570—).

From 7. topical conference on applications of radio-frequency power to plasmas; Kissimmee, FL, USA (4 May 1987).

We present an analysis of a rectangular dielectric-filled waveguide, suitable for ICRF heating. To simulate the H-mode, we take the edge plasma to consist of a pedestal of variable length followed by a region with either a parabolic or a gaussian variation. We present numerical results for the waveguide reflection coefficient, the equivalent surface plasma impedance and the electric field profile at the aperture, for a wide range of edge plasma conditions. A dielectric-filled rectangular waveguide launcher has been designed, fabricated and tested for the ICRF wave coupling. Our theoretical analyses and measurements over the 60—130 MHz range indicate that a very high power coupling efficiency ($\geqq$90%) can be obtained for a matched launcher with appropriate tuning of the noncontacting sliding short. An input reflection coefficient model has been developed for a matched or plasma-loaded waveguide launcher and compared with measurements.

44500 Modeling of compact loop antennas. Baity, F.W. (Oak Ridge National Laboratory, Oak Ridge, TN 37831). *AIP (American Institute of Physics) Conference Proceedings;* **159**: No. 1, 378-381(Sep 1987). (CONF-870570—).

From 7. topical conference on applications of radio-frequency power to plasmas; Kissimmee, FL, USA (4 May 1987).

A general compact loop antenna model which treats all elements of the antenna as lossy transmission lines has been developed. In addition to capacitively tuned resonant double loop (RDL) antennas, the model treats sub-tuned RDL antennas. Calculations using the model have been compared with measurements on full-scale mock-ups of RDL antennas for ATF and TFTR in order to refine the transmission line parameters. Results from the model are presented for RDL antenna designs for ATF, TFTR, Tore Supra, and the Compact Ignition Tokamak (CIT).

44501 Resonant loop antenna design with a 2-D steady-state analysis. Chen, G.L.; Ryan, P.M.; Hoffman, D.J.; Baity, F.W.; Swain, D.W.; Whealton, J.H. (Oak Ridge National Laboratory, Oak Ridge, TN 37831). *AIP (American Institute of Physics) Conference Proceedings;* **159**: No. 1, 382-385(Sep 1987). (CONF-870570—).

From 7. topical conference on applications of radio-frequency power to plasmas; Kissimmee, FL, USA (4 May 1987).

Evaluation of resonant loop antenna designs for ICRF heating of plasmas requires information concerning the electrical characteristics of the structure. The 2-D steady-state model described here provides current strap inductance and capacitance, surface current distributions, and flux linkage to the plasma. These are used to determine the current and voltage requirements, ohmic dissipation, frequency limits and matching requirements, maximum electric fields, and plasma loading in order to compare antenna designs.

44502 MHD surface wave calculations for a helical antenna. Booth, W.D.; Oaks, M.E.; Vu, L.N. (Department of Physics and Fusion Research Center, The University of Texas at Austin, Austin, Texas 78712). *AIP (American Institute of Physics) Conference Proceedings;* **159**: No. 1, 418-421(Sep 1987). (CONF-870570—).

From 7. topical conference on applications of radio-frequency power to plasmas; Kissimmee, FL, USA (4 May 1987).

Amagishi recently reported magnetic probe radial profile measurements of axial phase velocities and attenuation lengths for 449 and 605 kHz, m = -1 MHD surface waves launched by a two elment helical antenna. The experiments were carried out in a current free, linear machine (TPH). Using a kinetic code we have computed the plasma response to his antenna Fourier components. From the superposition we calculate an effective phase velocity and compare with Amagishi's results. Also presented are radial and axial profiles of the fields.

44503 **Solution to fusion.** Turanciol, F. (Fermi National Labs., Batavia, IL (US)). pp 17 of Contributions to the muon catalyzed fusion workshop. Idaho Falls, ID; Idaho National Engineering Lab. (1985). (CONF-840660—).

From Workshop on muon-catalyzed fusion reactions; Jackson, WY, USA (7 Jun 1984).

The new fundamentals of particle physics show that, PROTONS CAN INDUCE FUSION REACTIONS VIA NEGATIVE MUONS, when the conditions are right. These conditions can provide guidance to the successful designs of future fusion reactors. A sample design is disclosed for general consideration.

44504 **System concepts for muon-catalyzed fusion.** Miley, G.H. (Fusion Studies Lab., Univ. of Illinois, 214 Nuclear Engineering Lab., 103 S. Goodwin Avenue, Urbana, IL (US)). pp 131-141 of Contributions to the muon catalyzed fusion workshop. Idaho Falls, ID; Idaho National Engineering Lab. (1985). (CONF-840660—).

From Workshop on muon-catalyzed fusion reactions; Jackson, WY, USA (7 Jun 1984).

Concepts for muon-catalyzed fusion reactors are briefly reviewed. A hybrid for fissile fuel breeding appears feasible energetically. However, a full evaluation requires further study of various new engineering problems that arise. Key issues involved in various subsystems are outlined.

99 GENERAL AND MISCELLANEOUS

44505 **(UCID—21377) Intercultural communication and its impact on career development: A field study at LLNL.** Nissen, S.Y. (Lawrence Livermore National Lab., CA (USA)). Jan 1988. Contract W-7405-ENG-48. 25p. NTIS, PC A03/MF A01; GPO Dep. Order Number DE88008641/JAW.

The purpose of this investigation was to discover whether cultural and language difference have an impact on career development. This paper is a summary report of an informal survey of Chinese scientists and engineers at Lawrence Livermore National Laboratory. The survey data indicates that from the perspective of the Chinese scientists and engineers, they have not experienced communication difficulties. On the subject of stereotype evaluation and cultural conditioning, the data appears somewhat ambivalent. As to career advancement opportunities and comparable salaries, the majority of the respondents answered positively. 6 refs., 3 figs., 1 tab.

44506 **(UCRL—97343) Memorability of commands learned as keywords or function keys: A parallel to voice recognition interfaces.** Sorn, K.; Schultz, E.E. Jr. (Lawrence Livermore National Lab., CA (USA); California Univ., Davis (USA)). 15 Sep 1987. Contract W-7405-ENG-48. 10p. (CONF-8805124—1). NTIS, PC A03/MF A01;1; GPO Dep. Order Number DE88008575/JAW.

From CHI '88 conference; Washington, DC, USA (15 May 1988).

Voice recognition interfaces require users to input keywords to access and control functions. An experiment was conducted to compare user's memory for keywords relative to names of equivalent function keys. Thirty-five subjects attempted to learn word processing functions as keywords or in terms of the names of function keys which allowed access to and control of these functions. Keyword learning produced a significantly higher proportion of correct recalls and fewer intrusions (false recalls) after both an immediate retention test and an unexpected second test two weeks later. Superior keyword memorability is an important potential advantage of voice recognition interfaces.

9901 Management

REFER ALSO TO CITATION(S) 43168

44507 **(UCID—21401) A model recharge system for the LCC.** Carlson, R.E.; Hogan, C.B. (Lawrence Livermore National Lab., CA (USA)). 5 May 1988. Contract W-7405-ENG-48. 27p. NTIS, PC A03/MF A01. Order Number DE88010596/JAW.

This report describes a model recharge system for LCC. The model is based on the premise that the charges assessed should accurately reflect the actual cost to the LCC for the resources being used. The benefits of such a system include a sense of absolute fairness to all users, plus incentives to conserve scarce resources. In developing this model it has been necessary to make compromises between conflicting objectives - such as making the model complete and comprehensive while keeping it simple and manageable. When compromises have been made, a brief discussion of the rationale behind each compromise has been included. It is quite possible that additional compromises will have to be made as the model moves toward implementation.

9902 Mathematics And Computers

REFER ALSO TO CITATION(S) 43173, 43298, 43644, 43646, 43649, 43677, 43706, 44068

44508 **(ANL/MCS-TM—111) Guidelines for the design of symmetric eigenroutines, SVD, and iterative refinement and condition estimation for linear systems: LAPACK Working Note No. 4.** Demmel, J.; Du Croz, J.; Hammarling, S.; Sorensen, D. (Argonne National Lab., IL (USA). Mathematics and Computer Science Div.). Mar 1988. Contract W-31109-ENG-38. 29p. NTIS, PC A03/MF A01;1; GPO Dep. Order Number DE88010517/JAW.

This note summarizes the numerical and software issues which arise in designing the LAPACK subroutines for the symmetric eigenproblem, the singular value decomposition (SVD), and iterative refinement for linear systems. At the end of each chapter is a list of design questions for which we would like feedback from the user community.

44509 **(CMI-R—872341-3) Optimal shut down decisions in resource extraction.** Olsen, T.E.; Stensland, G. (Christian Michelsens Inst. for Vitenskap og Aandsfrihet, Bergen (Norway)). Oct 1987. 11p. NTIS (US Sales Only), PC A03/MF A01. Order Number DE88752100/JAW.

We give an analytic solution to the problem of when to stop production in resource extraction. The shut down decision is irreversible. Both price and production follow geometric diffusion processes while extraction costs are fixed. 5 refs.

44510 **(CMI-R—872341-4) Optimal sequencing of resource pools under uncertainty.** Olsen, T.E.; Stensland, G. (Christian Michelsens Inst. for Vitenskap og Aandsfrihet, Bergen (Norway)). Oct 1987. 15p. NTIS (US Sales Only), PC A03/MF A01. Order Number DE88752101/JAW.

This paper characterizes the optimal scheduling of extraction from two reserves under price and production uncertainty. An essential step in the analysis is the characterization of the optimal / sup s/witching date/sup /and the associated /sup f/lexibility value/sup ,/ i.e. the value of the option to switch production from the first to the second reserve. 7 refs.

44511 **(CMI-R—872341-5) Note on the value of waiting to invest.** Olsen, T.E.; Stensland, G. (Christian Michelsens Inst. for Vitenskap og Aandsfrihet, Bergen (Norway)). Nov 1987. 15p. NTIS (US Sales Only), PC A03/MF A01. Order Number DE88752098/JAW.

This paper extends previous results on the optimal timing of investment in an irreversible project when both the value of the project and the investment cost follow continuous-time stochastic processes. The optimal investment rate is generalized to the case where total costs consist of one stochastic and one deterministic component. 2 refs.

44512 **(CONF-8804113—2) Experience of using INGRES/ABF for large-scale applications.** Huber, C.; Robinson, G.; Schwartz, M. (Argonne National Lab., IL (USA); General Electric Co., Palmer, AK (USA)). 1988. Contract W-31-109-ENG-38. 26p. NTIS, PC A03/MF A01; 1; GPO Dep. Order Number DE88011976/JAW.

From Ingres User Association meeting; San Diego, CA, USA (24 Apr 1988).

Argonne National Laboratory, with the assistance of Resources, Inc., recently used INGRES to implement supporting data bases for a large scale simulation model for the Joint Chiefs of Staff. Data bases for both input and output data were created. Interfaces were created using INGRES/ABF. The input data base interface alone consists of 189 screens. Therefore, this was a good example of a large scale application using ABF. In order to implement this scale of application, a number of standards were developed. Four basic types of screens (each with two variants), together with the accompanying OSL code were defined. The input data base interface was designed using these standards. The output interface required many capabilities not easily implemented in OSL. This project tested and identified some problems and issues that should be addressed when using ABF. Limitations on naming conventions, functions within ABF, and configuration issues will be addressed. A major issue in large scale ABF applications is the difficulty of avoiding interference and wasteful activities when each member of a development team is responsible for a portion of the same application. The experience from this project brought insights that may be beneficial to others.

44513 **(CONF-8804113—4) Building a data base environment for large simulation models: The INBATIM application develoment experience.** Huber, C.; Robinson, G.; Schwartz, M. (Argonne National Lab., IL (USA)). 1988. Contract W-31109-ENG-38. 23p. NTIS, PC A03/MF A01;1; GPO Dep. Order Number DE88009924/JAW.

From Ingres User Association meeting; San Diego, CA, USA (24 Apr 1988).

Argonne National Laboratory is implementing a data base to support large scale military simulation models for the United States Joint Chiefs of Staff (JCS). JCS currently has a large number of models in production mode, with some being enhanced, and several new models under development. The purpose of the data base environment is to provide an easy to use, consistent interface between all the models and the user community; to standardize data definition; and to reduce training requirements. Argonne, with assistance from Resources, Inc., has completed building a data base environment for an existing, production level simulation model to demonstrate these concepts. This consisted of creating input and output data bases, user interfaces via full screens forms, and interfaces between the data bases and the model itself. A key requirement was that the model itself could not be modified because of quality control and distribution concerns. Overall throughput and performance were key concerns of the user community. Although performance was not the prime design concern of this demonstration project, some very interesting results were obtained. This paper will summarize the overall project and review the learning experience and results. 2 figs.

44514 **(CONF-8805110—2) Challenge problems focusing on equality and combinatory logic: Evaluating automated theorem-proving programs.** Wos, L.; McCune, W. (Argonne National Lab., IL (USA)). 1988. Contract W-31109-ENG-38. 12p. NTIS, PC A03/MF A01;1; GPO Dep. Order Number DE88010057/JAW.

From 9. international conference on automated deduction (CAD-9); Argonne, IL, USA (23 May 1988).

In this paper, we offer a set of problems for evaluating the power of automated theorem-proving programs and the potential of new ideas. Since the problems published in the proceedings of the first CADE conference proved to be so useful, and since researchers are now far more disposed to implementing and testing their ideas, a new set of problems to complement those that have been widely studied is in order. In general, the new problems provide a far greater challenge for an automated theorem-proving program than those in the first set do. Indeed, to our knowledge, five of the six problems we propose for study have never been proved with a theorem-proving program. For each problem, we give a set of statements that can easily be translated into a standard set of clauses. We also state each problem in its mathematical and logical form. In many cases, we also provide a proof of the theorem from which a problem is taken so that one can measure a program's progress in its attempt to solve the problem. Two of the theorems we discuss are of especial interest in that they answer questions that had been open concerning the constructibility of two types of combinator. We also include a brief description of a new strategy for restricting the application of paramodulation. All of the problems we propose for study emphasize the role of equality. This paper is tutorial in nature.

44515 **(DOE/ER/25006—3) Nonparametric methods in multivariate analysis: [Annual] progress report, July 15, 1985-November 30, 1987.** Buja, A.; O'Sullivan, F.; Stuetzle, W. (Washington Univ., Seattle (USA)). 1987. Contract FG06-85ER25006. 8p. NTIS, PC A02/MF A01; 1; GPO Dep. Order Number DE88012986/JAW.

This report briefly discusses the following topics: additional regression models; Graphical methods for viewing multivariate data; Design of a Lisp based system for interactive data analysis; constrained cluster analysis and image understanding; and surface smoothing. (LSP)

44516 **(DOE/ER/25026—19) A taxonomy for conjugate gradient methods.** Ashby, S.F.; Manteuffel, T.A.; Saylor, P.E. (Illinois Univ., Urbana (USA). Dept. of Computer Science). Mar 1988. Contract FG02-87ER25026;W-7405-ENG-48. 45p. (UIUCDCS-R—88-1414; UILU-ENG—88-1719). NTIS, PC A03/MF A01;1; GPO Dep. Order Number DE88008574/JAW.

The conjugate method of Hestenes and Stiefel is an effective method to solve large, sparse hermitian positive definite (hpd) systems of linear equations, $Ax = b$. Generalizations to non-hpd matrices have long been sought. The recent theory of Faber and Manteuffle gives necessary and sufficient conditions for the existence of CG method. This paper uses these conditions to develop and organize such methods. We show that any CG method for $Ax = b$ is characterized by and hpd inner product matrix B and a left preconditioning matrix C. At each step the method minimizes the B-norm of the error over a Krylov space. This characterization is then used to classify known and new methods. Finally, it is shown how eigenvalue estimates may be obtained from the iteration parameters, generalizing the well known connection between CG and Lanczos. Such estimates allow implementation of a stopping criterion based more nearly on the true error. 29 refs., 4 tabs.

44517 **(DOE/ER/25026—20) A practical shifted Adams algorithm.** Tam, Hon-Wah. (Illinois Univ., Urbana (USA). Dept. of Computer Science). Mar 1988. Contract FG02-87ER25026. 35p. (UIUCDCS-R—88-1420; UILU-ENG—88-1725). NTIS, PC A03/MF A01;1; GPO Dep. Order Number DE88008573/JAW.

This is a continuation of the study of the shifted Adams method. A previous report has suggested that the shifted Adams method might be more effective than the Adams method on nonstiff ordinary differential equations. A variable stepsize variable order Adams algorithm has been incorporated in the code ODE. This report generalizes this algorithm to the shifted Adams method. The generalized algorithm is implemented in a new code EFODE.

44518 **(ENEA-RT-TIB—85-3) BCSTO a Fortran code for Nilsson-Bardeen-Cooper-Schrieffer computations.** Maino, G. (ENEA, Rome (Italy)). 1985. 37p. (In Italian). NTIS (US Sales Only), PC A03/MF A01. Order Number DE88701729/JAW.

A FORTRAN code is described, that performs nuclear structure calculations, using a set of single-particle levels in a Nilsson potential, and including the pairing interaction between like nucleons in the frame of the superfluid model of Bardeen, Cooper and Schrieffer. Some results are presented and possible applications of the code are discussed.

44519 **(EPRI-NP—5656-CCM-Vol.1) GO software version 3.0: Volume 1, Overview: Computer Code Manual.** (Electric Power Research Inst., Palo Alto, CA (USA); EI International, Inc., Kent, WA (USA)). Jun 1988. 107p. Unlimited audience, publicly available. Research Reports Center, Box 50490, Palo Alto, CA 94303. Order Number TI88011935/JAW.

The GO Methodology is a success-oriented probabilistic system performance analysis technique. The methodology can be used to quantify system reliability and availability, identify and rank critical components and the contributors to system failure, construct event trees, perform statistical uncertainty analysis, and evaluate the effects of external events and common cause failures on system performance. This Overview Manual provides a description of the GO methodology, how it can be used, the benefits of using it in the analysis of complex systems, and a comparison of the methodology with fault tree analysis. 14 refs., 35 figs., 9 tabs.

44520 **(FNAL/C—88/43) Design, implementation, and operation of a class based batch queue scheduler for VAX/VMS.** Chadwick, K. (Fermi National Accelerator Lab., Batavia, IL (USA)). 20 May 1988. Contract AC02-76CH03000. 8p. (CONF-880569—2). NTIS, PC A02/MF A01; 1; GPO Dep. Order Number DE88012223/JAW.

From DECUS spring symposium; Cincinnati, OH, USA (16 May 1988).

Fermilab found that the standard VMS batch configuration options were inadequate for the job mix that exists on the Fermilab central computer facility VAX cluster. Accordingly, Fermilab designed and implemented a class based batch queue scheduler. This scheduler makes use of the standard VMS job controller and batch system. Users interact with the scheduler at job submission time by specification of CPU time limits and batch job characteristics. This scheduler allows Fermilab to make efficient use of our large heterogeneous VAX cluster which contains machines ranging from a VAX 780 to a VAX 8800. The scheduler was implemented using the VMS system services $GETQUI and $SNDJBC, without changes to the existing VMS job scheduler. As a result, the scheduler should remain compatible with future VMS versions. This session will discuss the design goals, implementation, and operational experience with Fermilab's class based batch queue scheduler.

44521 (INIS-mf—11210, pp II1-II3) **Artificial intelligence expert systems in the nuclear industry.** Yiftah, S. (Technion-Israel Inst. of Tech., Haifa. Dept. of Nuclear Engineering). Dec 1987. NTIS (US Sales Only), PC A13/MF A01. Order Number DE88780087/JAW. (CONF-871287—).

From Nuclear Societies of Israel annual meeting; Haifa, Israel (21 Dec 1987).

Transactions.; V. 14.

44522 (INIS-mf—11210, pp II8-II21) **Activities of IAEA in probabilistic safety assessment.** Lederman, L. (International Atomic Energy Agency, Vienna (Austria)). Dec 1987. NTIS (US Sales Only), PC A13/MF A01. Order Number DE88780087/JAW. (CONF-871287—).

From Nuclear Societies of Israel annual meeting; Haifa, Israel (21 Dec 1987).

Transactions.; V. 14.

Published in summary form only.

44523 (INIS-mf—11210, pp V12-V15) **Inverse uncertainty analysis.** Ronen, Y. (Ben-Gurion Univ. of the Negev, Beersheba (Israel). Dept. of Nuclear Engineering). Dec 1987. NTIS (US Sales Only), PC A13/MF A01. Order Number DE88780087/JAW. (CONF-871287—).

From Nuclear Societies of Israel annual meeting; Haifa, Israel (21 Dec 1987).

Transactions.; V. 14.

44524 **(KFKI—1987-58/G) DUMA - a program to display distributions in hexagonal geometry.** Tran Quoc Dung; Makai, M. (Hungarian Academy of Sciences, Budapest. Central Research Inst. for Physics). Sep 1987. 14p. NTIS (US Sales Only), PC A03/MF A01. Order Number DE88701767/JAW.

DUMA program displays hexagonal structures applied in WWER-440 reactors or one or two distributions in them. It helps users to display either integer, literal or real arrays in an arbitrary hexagonal structure. Possible applications: displaying reactor core layout, power distribution or activity measurements.

44525 **(LBL—24137) Analytical modeling of materialized view maintenance algorithms.** Srivastava, J.; Rotem, D. (California Univ., Berkeley (USA). Computer Science Div.; Lawrence Berkeley Lab., CA (USA)). Oct 1987. Contract AC03-76SF00098. 18p. (CONF-8803117—1). NTIS, PC A03/MF A01; 1; GPO Dep. Order Number DE88012018/JAW.

From 7. annual symposium on principals of database systems; Austin, TX, USA (21 Mar 1988).

In the recent past there has been increasing interest in the idea of maintaining materialized copies of views, and use them to process view queries [ADIB 80, LIND 86, BLAK 86, ROSS 86, HANS 87]. Various algorithms have been proposed, and their performance analyzed. However, there does not exist a comprehensive analytical framework under which the problem can be systematically studied. We present a queueing model which facilitates both a systematic study of the problem, and provides a means to compare various proposed algorithms. Specifically, we propose a parametrized approach in which both the user and system viewpoints are integrated, and the setting of the parameter decides the relative importance of each table.

44526 **(LBL—24767) Precision-time tradeoffs: a paradigm for processing statistical queries on databases.** Srivastava, J.; Rotem, D. (California Univ., Berkeley (USA). Computer Science Div.; Lawrence Berkeley Lab., CA (USA)). May 1988. Contract AC03-76SF00098. 22p. (CONF-8806166—1). NTIS, PC A03/MF A01; 1; GPO Dep. Order Number DE88012024/JAW.

From 4. international working conference on statistical and scientific database management; Rome, Italy (21 Jun 1988).

Conventional query processing techniques are aimed at queries which access small amounts of data, and require each data item for the answer. In case the database is used for statistical analysis as well as operational purposes, for some types of queries a large part of the database may be required to compute the answer. This may lead to a data access bottleneck, caused by the excessive number of disk assesses needed to get the data into primary memory. An example is computation of statistical parameters, such as count, average, median, and standard deviation, which are useful for statistical analysis of the database. Yet another example that faces this bottleneck is the verification of the truth of a set of predicates (goals), based on the current database state, for the purposes of intelligent decision making. A solution to this problem is to maintain a set of precomputed information about the database in a view or a snapshot. Statistical queries can be processed using the view rather than the real database. A crucial issue is that the precision of the precomputed information in the view deteriorates with time, because of the dynamic nature of the underlying database. Thus the answer provided is approximate, which is acceptable under many circumstances, especially when the error is bounded. The tradeoff is that the processing of queries is made faster at the expense of the precision in the answer. The concept of precision in the context of database queries is formalized, and a data model to incorporate it is developed. Algorithms are designed to maintain materialized views of data to specified degrees of precision.

44527 **(ORNL/TM—10668) ORNL system for measurement of telephone-line attenuation.** Rochelle, R.W.; Williams, I.E. (Oak Ridge National Lab., TN (USA)). Jun 1988. Contract AC05-84OR21400. 17p. NTIS, PC A03/MF A01;1; GPO Dep. Order Number DE88012115/JAW.

The purpose of modifying the TS-100 Automated Tempest Test System software was to use the equipment for making radio-frequency attenuation measurements between an input port and an output port of a telephone network. One set of tests was performed to simulate the electromagnetic radiation from a secure computer terminal and its coupling to telephone lines within a building. Another set of tests was conducted to determine the procedures for measuring attenuation on telephone lines between buildings that are all within the secure zone. The measurements indicate that attenuation between the terminal and the telephone is a function of many variables; however, attenuation in the cable between the buildings is proportional to the length of the cable between the buildings. 1 ref., 2 figs.

44528 **(ORNL/TM—10778) Survey of the literature on fractals with possible applications to phase change processes.** Renker, L.A.; Wilson, D.G. (Oak Ridge National Lab., TN (USA)). Jun 1988. Contract AC05-84OR21400. 20p. NTIS, PC A03/MF A01;1; GPO Dep. Order Number DE88012240/JAW.

This paper is a partial collection of the literature on fractals and how it applies to phase change processes, specifically solidification. Fractals can be used to model the dendrites that are formed at the interface between a liquid and a solid with restrictions because either dendrites or non-dendritic fractals may be formed by diffusion limited solidification, depending on the presence of crystalline anisotropy. This anisotropy causes the tips of the structure being formed to remain stable, leading to the information of a dendrite, rather than splitting to form a non-dendritic fractal. An additional type of structure is found when electrodeposition is used to model solidification. The formation of this dense radial structure depends on the level of the voltage and the electrolyte concentration. These structures are formed at intermediate values where the crossover from non-dendritic fractals to dendrites occur. Non-dendritic fractals are formed at the lower values and dendrites are formed at the higher values. A comprehensive bibliography is included with this paper. 82 refs., 4 figs.

44529 **(SAND—87-2131) ANVIL-5000/DRAM interface user's guide.** Harris, R.N. (Sandia National Labs., Albuquerque, NM (USA)). Jun 1988. Contract AC04-76DP00789. 22p. NTIS, PC A03/MF A01;1; GPO Dep. Order Number DE88012107/JAW.

This document defines the procedure for linking an ANVIL-5000 CAD layout to the dynamic analysis program, DRAM. Included are instructions for preparing a specialized CAD assembly drawing and an explanation of the procedure required to produce the dynamic analysis data set. 5 refs., 5 figs.

44530 **(SAND—87-2356) The SAS System by forms: Putting statistical power into the hands of an end-user.** Lee, J.W. (Sandia National Labs., Albuquerque, NM (USA)). Apr 1988. Contract AC04-76DP00789. 16p. NTIS, PC A03/MF A01;1; GPO Dep. Order Number DE88010512/JAW.

A major step in speed and flexibility in statistical calculations was achieved with fourth-generation languages like base SAS software. Programming is reduced to a few lines of commands and options. However, because of the proliferation of options, proper training is required to learn which lines of code (with proper syntax) will achieve the desired purpose. Since most end-users lack this training, fourth-generation languages have fallen short of their potential. Canned SAS programs written for applications that reference a limited and static database are a possible solution. These programs, however, are not effective in a dynamic environment where multiple datasets are individually defined and are unstable, i.e., they change in time. With a database of several hundred different datasets, producing a single application for each dataset would be difficult, let alone providing the flexible functionality that is desired. In this report, we hope to demonstrate how the full power of the SAS System can be integrated so that end-users with limited training can perform their own analyses in this environment. Specifically, we will describe how SAS software is integrated into a menu-driven, interactive retrieval and analysis system (MIRACLE).

44531 **(SAND—88-0584C) Model-based problem-solving and semantic control of the ATMS [Assumption-Based Truth Maintenance System].** Mitchiner, J.L.; Phillips, L.R.; Blacker, T.D.; Lin, Y.T. (Sandia National Labs., Albuquerque, NM (USA)). 1988. Contract AC04-76DP00789. 14p. (CONF-880835—1). NTIS, PC A03/MF A01; 1; GPO Dep. Order Number DE88006844/JAW.

From 7. national conference on artificial intelligence; St. Paul, MN, USA (22 Aug 1988).

Extending formal techniques to solve large, real problems is difficult because of the size and complexity of the state spaces. As size increases, solution techniques having the desired formal properties are often useless or impractical because of the frame problem, interacting subgoals, and combinatorial explosions. This paper presents a Model-Based Problem Solver (MPS) that efficiently builds solutions of the desired quality for a class of large, real problems. The MPS semantically evaluates partially constructed direct models to avoid the frame problem to determine the correct ordering of operations, and to control the creation of Assumption-Based Truth Maintenance System (ATMS) context space for generating finite element meshes. Automatic quadrilateral finite element mesh generation is a long-sought engineering analysis capability. The Automated MEshing Knowledge System (AMEKS) automatically decomposes 2-D regions, with boundaries composed of straight and curved lines, into primitive shapes that can then be meshed algorithmically. The MPS does this in linear time, even though the state space grows exponentially with the number of solution steps. In one example of a real part, an exhaustive search would require more than 54,000 ATMS contexts. AMEKS constructs and recognizes a useful decomposition using only 26 contexts. 11 refs., 6 figs.

44532 **(SAND—88-0689) The Product Data Network and Distributed Data System: Conceptual Node Model.** Hall, R.C. (Sandia National Labs., Albuquerque, NM (USA)). Jun 1988. Contract AC04-76DP00789. 40p. NTIS, PC A03/MF A01;1; GPO Dep. Order Number DE88012113/JAW.

The current environment of the Product Test Data/Systems Evaluation (PTD/SE) VAXcluster is examined with particular emphasis on hardware and data communications features of the system. The PTD/SE system provides data acquisition, storage, and retrieval to support analysis in nuclear weapon engineering and system-evaluation applications. A general node model is presented to establish a conceptual basis for enhancement and integration of the PTD/SE applications. The model supports local integration of functions within a single autonomous node, as well as integration of functions and data distributed among similar nodes participating in a Product Data Network. The practicality of implementing a distributed data system is explored within the context of the model. Network nodes throughout the Nuclear Weapon Complex would comprise a Product Data Network which could make weapon evaluation data available to Nuclear Weapon Complex engineers having the proper need to know. 5 refs., 5 figs., 1 tab.

44533 **(UCID—21368) The view signal and image processing system.** Brase, J.M.; Miller, V.J.; Wieting, M.G. (Lawrence Livermore National Lab., CA (USA)). Mar 1988. Contract W-7405-ENG-48. 88p.

VIEW is a system for processing arbitrary multi-dimensional signals. It provides facilities for numerical operations, signal displays, and signal databasing. The major emphasis of the system is on the processing of time-sequences and two-dimensional images. The system is designed to be both portable and extensible. It currently runs on both VAX/VMS systems and SUN workstations. This document provides an introduction to VIEW through an example session and gives overviews ofthe VIEW signal databae and user environment. Summaries of each command are given with a functional and alpabetical index for easy reference.

44534 **(UCID—21380) Model-based computed tomography for nondestructive evaluation: An overview and proposal.** Azevedo, S.G. (Lawrence Livermore National Lab., CA (USA)). 16 Jan 1988. Contract W-7405-ENG-48. 74p. NTIS, PC A04/MF A01;1; GPO Dep. Order Number DE88010600/JAW.

A research plan for computationally solving the hollow projections problem in computed tomography (CT) imaging of industrial objects is proposed. The algorithms studied are those best suited for nondestructive evaluation (NDE) of industrial objects where applicable mathematical models are available and where the objective is to improve the diagnostic image quality. The hollow projections problem occurs when the relative x-ray attenuations of various regions in the inspected object are vastly different. Some of the projected x-rays are completely attenuated (no photons are received) thereby reducing the information in the measured signals. In this case, conventional reconstruction algorithms produce artifacts in the reconstructed image. Background material about the current capabilities and limitations of CT systems makes up the bulk of this paper. Various design parameters for a generic CT scanner are described in terms of both the data acquisition and the image reconstruction phases. In particular, those specifications which distinguish NDE inspections from medical imaging are out-

lined. The mathematics of CT{emdash}the Radon transform and its various inverses{emdash}with discretization effects is reviewed briefly. The current algorithmic techniques based on those mathematics are summarized. More recent algorithms described in the literature for operating on limited and noisy data are given special consideration. Some of these methods present novel ways of using a priori information in the reconstruction process. A detailed proposal of the research effort planned for the next few years concludes the report. 225 refs., 7

44535 **(UCID—21422) KRYSI, an ODE solver combining a semi-implicit Runge-Kutta method and a preconditioned Krylov method.** Hindmarsh, A.C.; Noersett, S.P. (Lawrence Livermore National Lab., CA (USA); Trondheim Univ. (Norway). Div. of Mathematical Sciences). May 1988. Contract W-7405-ENG-48. 31p. NTIS, PC A03/MF A01;1; GPO Dep. Order Number DE88012245/JAW.

This report describes KRYSI, a solve for ODE initial value problems that uses a combination of two powerful techniques in the case of stiff systems. KRYSI is based on the SIMPLE solver, and (like SIMPLE) uses a 3-stage 3rd order SDIRK method. When solving the implicit stage equations in the stiff case, both use some form of Newton iteration. But there, KRYSI (unlike SIMPLE) uses a Krylov subspace iteration method, called SPIGMR : scaled Preconditioned Incomplete Generalized Minimum Residual method. The SPIGMR algorithm is outlined in the SDIRK context. No explicit Jacobian storage is required, except where used in preconditioning. The KRYSI package and its usage are described briefly. One test (demonstration) problem is given, along with a description of two preconditioners that are natural for its solution by KRYSI. The KRYSI solution results are given, and compared with those of LSODPK, a solver that combines a BDF method with the same SPIGMR algorithm. 11 refs., 1 fig.

44536 **(UCRL—53863) Gaussian techniques on shared-memory multiprocessors.** Darmohray, G.A. (Lawrence Livermore National Lab., CA (USA)). Apr 1988. Contract W-7405-ENG-48. 105p. NTIS, PC A06/MF A01;1; GPO Dep. Order Number DE88010594/JAW.

The performance characteristics of numerical algorithms running on single processor computers are well understood in terms of operation count and vectorization. When examining algorithm performance on a shared-memory multiprocessor one must consider, in addition to operation count and vectorization, the effects of processor synchronization, serial sections, memory access conflicts, and load imbalances. In this thesis the performance of Gauss and Gauss-Jordan elimination on a shared-memory multiprocessor is considered. Because real multiprocessors with appropriately pipelined functional units and suitably large numbers of processors are not yet available, the Cerberus multiprocessor simulator is used to evaluate algorithm performance. A general purpose synchronization strategy using barriers to satisfy data dependencies is commonly used in parallel algorithms. The barrier requires that processors wait for all other processors to arrive before execution is continued. Barrier synchronization can be used to satisfy most data dependencies, but in many cases is more than is needed. A key result of this work is that a custom synchronization strategy which explicitly exploits data dependencies of the Gauss elimination algorithm can outperform the generic barrier synchronization strategy without special hardware support for synchronization operations. When one is studying algorithms for multiprocessors, the traditional operation count analysis can be a poor predictor of performance. An algorithm which might be a poor performance choice on a single-processor vector architecture might become the star performer on a multiprocessor. Another result of this work is that Gauss-Jordan elimination, which has an operation count 50% greater than Gauss elimination, can perform better than the latter algorithm as the number of processors is increased for a fixed problem size.

44537 **(UCRL—97937) Smooth appearance for polygonal surfaces.** Max, N.L. (Lawrence Livermore National Lab., CA (USA)). Jan 1988. Contract W-7405-ENG-48. 34p. (CONF-880829—1). NTIS, PC A03/MF A01; 1; GPO Dep. Order Number DE88005677/JAW.

From Association for Computing Machinery (SIGGRAPH '88); Atlanta, GA, USA (1 Aug 1988).

Current shading methods for polygonal approximations to smooth surfaces reveal the polygon edges by lack of smoothness in the shading, texture, reflection lines, intersections, profiles, and shadows. These defects are eliminated here by interpolating the perspective depth in screen coordinates with a C^1 piecewise- polynomial function, defined over triangles in the screen plane. The three eye-space components of the surface normal, and the two texture parameters, are separately interpolated with similar C^1 functions. For smooth intersections, the depth comparison test of Watkins' polygon-based span-coherence scan-line algorithm is replaced by a simple test which uses closed-form solutions to polynomials of degree 2, 3, or 4. When the scan lines arise from scan planes containing the eye and the light source a version of the shadow volume algorithm can also generate smooth cast shadows. However, the C^1 functions do not give smooth profiles or boundaries edges. These must be approximated by suitable subdivision of the original polygons. 23 refs., 13 figs.

44538 **(UCRL—98303) Experience of implementing applicative parallelism on Cray X-MP.** Lee, Ching-Cheng. (Lawrence Livermore National Lab., CA (USA)). May 1988. Contract W-7405-ENG-48. 8p. (CONF-880975—1). NTIS, PC A02/MF A01; 1; GPO Dep. Order Number DE88011728/JAW.

From CONPAR '88; Manchester, UK (12 Sep 1988).

The traditional approach on Cray multiprocessing has been multitasking in FORTRAN environments with operating system support. This kind of approach usually requires explicit user intervention to restructure or reformulated the algorithms to control parallel execution. However, it is error-prone and in most cases, only coarse-grain parallelism such as subrountines or functions was explored. In this paper, an implemention of micro-tasking for an applicative language called SISAL on Cray X-MP is reported. The experience indicates where the automatic approach to parallelization works well, as well as sources of inefficient behavior on the Cray X-MP. The experience also suggests some future improvements of SISAL multiprocessing on Cray X-MP. 9 refs., 1 fig.

44539 **Programming style: An example.** Welch, L.C. (Physics Division, Argonne National Laboratory, Argonne, Illinois 60439). *Computers in Physics;* **2**: No. 5, 65-75(Sep 1988).

The relationship of programming style and "quality of software" is discussed. The quality of software is defined not only in objective terms, such as whether or not the answers are correct and the speed with which they are produced, but also in more subjective terms such as maintainability and readabilty. Examples in FORTRAN and C illustrate how stylistic features can improve software quality.

44540 **Long range correlations in linear congruential generators.** Percus, O.E.; Percus, J.K. (Courant Institute of Mathematical Sciences, New York University, 251 Mercer Street, New York, New York 10012). *Journal of Computational Physics;* **77**: No. 1, 267-269(Jul 1988).

Primitive linear congruential random number generators introduce correlations among elements separated by powers of two which thereby introduce errors into Monte Carlo procedures. A generalization of this phenomenon is made in this paper to all linear congruential generators with fixed multiplier using a power of two as modulus. (AIP)

9903 Information Handling

REFER ALSO TO CITATION(S) 43172, 43989, 44513

44541 **(IAE—4495/16) Application of data base management systems for developing experimental data base using ES computers.** Vasil'ev, V.I.; Karpov, V.V.; Mikhajlyuk, D.N.; Ostroumov, Yu.A.; Rumyantsev, A.N. (Gosudarstvennyj Komitet po Ispol'zovaniyu Atomnoj Ehnergii SSSR, Moscow. Inst. Atomnoj Ehnergii). 1987. 23p. (In Russian). NTIS (US Sales Only), PC A03/MF A01. Order Number DE88703509/JAW.

Modern data base measurement systems (DBMS) are widely used for development and operation of different data bases by assignment of data processing systems in economy, planning, management. But up today development and operation of data masses with experimental physical data in ES computer has been based mainly on the traditional technology of consequent or index-consequent files. The principal statements of DBMS technology applicability for compiling and operation of data bases with data on physical experiments are formulated based on the analysis of DBMS opportunities. It is shown that application of DBMS allows to essentially reduce general costs of calculational resources for development and operation of data bases and to decrease the scope of stored experimental data when analyzing information content of data. 24 refs.

44542 **(UCRL—15952-Rev.1) Honeywell technical order transfer tests.** (Lawrence Livermore National Lab., CA (USA); SYSCON Corp., San Diego, CA (USA)). 1 Feb 1988. Contract W-7405-ENG-48. 41p. (AITI—87-003). NTIS, PC A03. Order Number DE88012232/JAW.

This report covers testing being conductd by the Air Force Logistics Command on the Military Standard for the Automated Interchange of Technical Information (AITI). The objective is to demonstrate the validity of the transfer protocol defined in the standard and the viability of standarized formats for the transfer of technical information defined in other specifications used by the standard. 1 fig., 3 tabs.

44543 **(UCRL—21058) Boeing Military Airplane Company technical order transfer tests.** (Lawrence Livermore National Lab., CA (USA); SYSCON Corp., San Diego, CA (USA)). 1 Feb 1988. Contract W-7405-ENG-48. 29p. (AITI—87-005). NTIS, PC A03. Order Number DE88012233/JAW.

This report covers testing being conducted by the Air Force Logistics Command on the Military Standard for the Automated Interchange of Technical Information (AITI). The objective is to demonstrate the validity of the transfer protocol defined in the standard and the viability of standardized formats for the transfer of technical information defined in other specifications used by the standard. 6 tabs.

44544 **(UCRL—96080-Rev.1) Layering central authentication on existing distributed system interactive services.** Nessett, D.M. (Lawrence Livermore National Lab., CA (USA)). Oct 1987. Contract W-7405-ENG-48. 19p. (CONF-8806140—1-Rev.1). NTIS, PC A 03; 3; GPO Dep. Order Number DE88011347/JAW.

From 8. IEEE international conference on distributed computing systems; San Jose, CA, USA (13 Jun 1988).

Provision of interactive terminal service in a distributed system requires mechanisms to logon and logoff as well as to move textual data between the terminal host and remote host. Logon occurs in most distributed systems subsequent to the establishment of a terminal session by means of host specific logon procedures. However, in a distributed system of any size, this approach leads to security and password management problems. When the distributed system is centrally administered, these problems can be rectified through the use of a central authentication service that presents a common logon interface to the user for all distributed system hosts. Normally, central authentication is provided by either initially designing it into a distributed system or supporting it through the modification of distributed system and host operating system software. As an alternative strategy, central authentication can be layered onto existing interactive terminal services. Research to assess the feasibility of this approach was carried out. The results demonstrate that layering can be used in certain circumstances to provide central authentication services. The research also determined what terminal service features are necessary so that central authentication is easily layered on existing interactive terminal services. Recommendations are made concerning how to structure terminal services in a distributed system to support an integrated central authentication service.